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PHYSICS AND MATHEMATICS

No. 58

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USSR REPORT

PHYSICS AND MATHEMATICS

No. 58

This serial publication contains articles, abstracts of articles and news items from USSR scientific and technical journals on the specific subjects reflected in the table of contents.

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[III - USSR - 21H S&T]

USSR UDC: 534.286+534.16+534.0:534.26

DIFRACTION OF SURFACE ACOUSTICAL WAVES IN QUARTZ

Moscow AKUSTICHESKIY ZHURNAL Vol 25 No 4 Jul/Aug 79 pp 481-487 manuscript received 31 Jul 78

ANISIMKIN, V. I., MOROZOV, A. I. and NIKITIN, I. P., Institute of Radio Engineering and Electronics, USSR Academy of Sciences

[Abstract] Approximate functions $\Phi(\theta)$ are obtained for the XY-, YZ- and XZ- planes of quartz, where Φ is the angle of diffraction divergence of surface acoustical waves in an isotropic medium and θ is the angle between the wave perpendicular and the crystallographic axis selected. Φ was measured by means of acousticoelectronic probing in a system of mutually parallel straight lines. Figures 4, References 17: 5 Russian, 12 Western.

[34-6508]

USSR UDC: 534.222

PARAMETRIC INTERACTION OF SONIC BEAMS

Moscow AKUSTICHESKIY ZHURNAL Vol 25 No 4 Jul/Aug 79 pp 488-494 manuscript received 22 Dec 78

BAKHBALOB, N. S., ZHILEYKIN, YA. M. and ZABOLOTSKAYA, YE. A., Moscow State University imeni M. V. Lomonosov; Scientific Research Computer Center

[Abstract] This work is dedicated to the study of the behavior of the difference wave which develops on interaction of sonic beams of finite amplitude under conditions such that the nonlinear and diffraction effects are of the same order, and when nonlinearity is more strongly manifested than diffraction. Within the area of the beam, the amplitude and phase distributions of the difference wave and one of the high-frequency pumping waves are studied at a fixed distance from the boundary of the nonlinear medium, as well as the change in amplitudes and phases of these waves in the direction of propagation at various points on the cross section of the beam. Quasiplannar waves are studied in ideal and dissipative media with various relationships of nonlinear and diffraction effects, various ratios of frequencies of the carrier waves, for media with various levels of absorption Two amplitude distributions through the cross sections of the beam are studied: as defined by a fourth-power polynomial and by the Gaussian distribution. Figures 9; references 11: 9 Russian, 2 Western.

[34-6508]

USSR UDC: 534.231

WAVE NUMBERS AND PHASE DIFFERENCE BETWEEN COMPONENTS OF A SONIC FIELD IN A THREE-LAYER WAVEGUIDE

Moscow AKUSTICHESKIY ZHURNAL Vol 25 No 4 Jul/Aug 79 pp 507-514 manuscript received 6 Feb 78; in final version, 23 Jan 79

GONCHARENKO, B. I., ZAKHAROV, L. N. and IVANOV, V. YE., Moscow State University imeni M. V. Lomonosov, Physics Department, Acoustics Section

[Abstract] A study is made of the influence of changes in the parameters of a stratified medium of the bottom of a reservior on the vertical wave numbers and phase difference in the range of frequencies for which one normal wave propagates in the overlying liquid layer, the length of the sonic wave being comparable with the depth of the water. Estimates are made of the frequency areas in which slight changes in parameters of the model of the bottom lead to significant changes in phase difference, which can be measured experimentally. The influence of the sonic energy refracted in the bottom on the normal wave propagating in the liquid layer is not considered. Figures 7; references 13: 9 Russian, 4 Western.

[34-6508]

USSR UDC: 534.232:535.211

RADIATION OF SOUND BY AN OPTICOASCOUSTICAL SOURCE MOVING OVER A FINITE TRAJECTORY

Moscow AKUSTICHESKIY ZHURNAL Vol 25 No 4 Jul/Aug 79 pp 547-555 manuscript received 5 Seo 78

KOLOMENSKIY, AL. A., Institute of Physics imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] A study is made of the radiation of sonic waves from an area of thermal sources arising in a liquid half space as a result of absorption of the radiation of a pulsed laser, the beam of which is shifted over the surface of the liquid. It is assumed that at the initial moment, the laser beams strikes an unperturbed free liquid surface filling a half space, then moves over the surface at a constant speed in the positive direction along the index axis for a finite period of time, after which the trailing edge of the laser pulse reaches the surface of the liquid. The pulse is considered rectangular. Figures 3; references 11: Russian.

[34-6508]

USSR UDC: 534:232

OPTICAL GENERATION OF SOUND IN A LIQUID HALF SPACE BORDERING WITH A SOLID LAYER

Moscow AKUSTICHESKIY ZHURNAL Vol 25 No 4 Jul/Aug 79 pp 566-574 manuscript received 24 Jul 78

LYAMSHEV, L. M., Acoustics Institute imeni Academician N. N. Andreyev, USSR Academy of Sciences

[Abstract] An earlir work by the author studied the optical generation of sound in a liquid half space when its surface contracted another liquid and when intensity-modulated laser radiaiton was absorbed in the two-layer medium. Detailed results are presented in this work of similar case, except that the liquid in the half space is in contact with a solid, for example a thin elastic plate. Assuming that there is a thin elastic plate at the boundary of a liquid with a vacuum and that an intensity-modulated laser beam propagating in the positive direction along the z axis of a rectangular system of coordinates strikes the plate. The specifics of the sonic field created by the laser beam in the liquid are studied. The thermal mechanism of optical generation of sound is analyzed. Actually, an electrostriction mechanism of generation is also possible, but its contribution is considered small. Figures 5; references 12: 10 Russian, 2 Western.

[34-6508]

USSR UDC: 534.26:534.833

ISOLATION OF FLEXURAL WAVES AND SONIC RADIATION ON LINEAR HETEROGENEITIES of plates

Moscow AKUSTICHESKIY ZHURNAL Vol 25 No 4 Jul/Aug 79 pp 575-582 manuscript received 14 Aug 78

LYAPUNOV, V. T. and ROZHINOVA, T. D.

[Abstract] A study is made of the propagation of a harmonic flat flexural wave through a linear obstacle located on a plate at the zero point on the x axis. The plate is assumed to be in contact with the liquid (on one or both sides). A system of differential equations is derived which describes the joint oscillations of the plate and the liquid. The study is limited to frequencies below the critical frequency. Equations are derived which can define not only the vibration isolating properties of the obstacle, but also the fraction of the energy of the flexural wave which is transformed to sonic energy. Figures 3; references 7: 4 Russian, 3 Western.

[34-6508]

USSR UDC: 534-14:535

NONLINEAR THEORY OF THE THERMAL MECHANISM OF GENERATION OF SOUND BY LASER RADIATION

Moscow AKUSTICHESKIY ZHURNAL Vol 25 No 4 Jul/Aug 79 pp 622-625 manuscript received 9 Nov 78

DUNINA, T. A., YEGEREV, S. V., LYAMSHEV, L. M. and NAUGOL'NYKH, K. A., Acoustics Institute imeni Academician N. N. Andreyev, USSR Academy of Sciences

[Abstract] A study is made of the process of generation of sound by a laser pulse perpendicularly striking the free surface of a liquid. Heating of that portion of the liquid which absorbs the light causes it to expand; this causes radiation of sound. The dimensions of the area radiating sound are determined by the radius of the laser beam and its path length in the liquid. A figure illustrates the results of calculation of the form of the acoustical signal at an observation point located on the z axis at some distance from the point of impact. The acoustical signal excited by a long, intensity-modulated laser pulse is also calculated. Figures 2; references 6: 4 Russian, 2 Western.

[34-6508]

USSR UDC: 534+534.231.2

FLUCTUATION IN THE ANGLE OF ARRIVAL OF A PLANE WAVE PROPAGATING THROUGH THE SEA AT A LINEAR ANTENNA

Moscow AKUSTICHESKIY ZHURNAL Vol 25 No 4 Jul/Aug 79 pp 625-628 manuscript received 26 Jul 78; after revision, 11 Jan 79

YELISEYEVNIN, V. A., Acoustics Institute imeni Academician N. N. Andreyev, USSR Academy of Sciences

[Abstract] The dispersions of fluctuations of the angle of arrival of a plane wave repeatedly reflected from the surface of the sea and scattered on turbulent heterogeneities in the wave layer are calculated. Amplitude fluctuations are ignored, and the analysis extends only to random phase delays. The sonic field is calculated by the method of Kirkhoff in the Eckart approximation. In both of the two cases of scattering studied, the angle of arrival of the wave at the antenna was calculates without considering acoustical refraction in the layer of water. Figures 2; references 8 Russian.

[34-6508]

USSR

SPECIFICS OF THE DISPERSION OF PHASE VELOCITY AND STRUCTURE OF SURFACE WAVES IN MULTILAYER SYSTEMS

Moscow AKUSTICHESKIY ZHURNAL Vol 25 No 5, Sep/Oct 79 pp 641-645 manuscript received 11 Dec 78

BAUSK, YE. V., LOBANOVA, G. A. and YAKOVKIN, I. B., Institute of Semiconductor Physics, Siberian Department, USSR Academy of Sciences

[Abstract] A study is made of the question of the dispersion properties of multilayer systems in whcih an isotropic material serves as the substrate, while the overlying layer is a piezomaterial of class 6mm with C axis perpendicular to the free surface. Systems studied include ZnO-SiO_2 (fused), CdS-SiO_2 (fused), CdSe-SiO_2 (fused), ZnO-glass, CdS-glass and CdSe-glass. A comparison is presented of the results of calculation of the dispersion by two approaches: 1) a simplified approach, in which the layer is assumed to be elastically isotropic and nonpiezoelectric; and 2) a point approach, in which the anisotropy and piezoelectric properties of the semiconductor layer are considered. The results show that the dispersion of phase velocity for a quasirayleigh wave can be approximated with good accuracy by isotropic and nonpiezoelectric films over a broad range of values of kH (where k is the wave number and H is layer thickness). Figures 4; references 4 Western.

[35-6508]

USSR

NATURAL OSCILLATIONS OF A GAS TORUS IN A LIQUID

Moscow AKUSTICHESKIY ZHURNAL Vol 25 No 5 Sep/Oct 79 pp 653-660 manuscript received 25 Aug 76; in final form, 29 Mar 79

VASIL'YEV, V. A., Acoustics Institute imeni N. N. Andreyev, USSR Academy of Sciences

[Abstract] When acoustical (and other) devices must be immersed in water, the pressure inside the chanber containing the devices is frequently maintained equal to the water pressure by the simple expedient of connecting an ordinary inner tube with the internal space of the instrument chamger through a thin rubber hose. Thus, as the instruments are submerged, the inner tube is squeezed by the increasing water pressure, and part of the air in the inner tube enters the instrument chamber, maintaining the pressure inside the chamber equal to the surrounding water

water pressure. However, particularly for acoustical instrument, this means that the instrument responds not only to the incoming signal wave, but also to the oscillations of the air in the connected air space consisting of the interior of the instrument chamber plus the inner tube. This article studies the natural oscillating frequencies of toroidal air volumes, to allow partial compensation for this phenomenon. Figures 3; references 7: 4 Russian, 3 Western.

[35-6508]

USSR

CORRELATION OF PSEUDONOISE SIGNALS REFLECTED FROM THE FLOOR OF THE OCEAN WITH RADIATED SIGNALS

Moscow AKUSTICHESKIY ZHURNAL Vol 25 No 5 Sep/Oct 79 pp 675-680 manuscript received 19 Dec 78

VOLOVOV, V. I., LYSANOV, YU. P. and SECHKIN, V. A., Institute of Acoustics imeni Academician N. N. Andreyev, USSR Academy of Sciences

[Abstract] Some results are presented from an experimental study of the correlation characteristics of pseudonoise signals as they are reflected from the floor of the ocean, and the results are interpreted on the basis of an approximate theory of scattering of waves on uneven surfaces. Particular attention is given to analysis of the quantitative characteristics of mutual correlation of the reflected signals and the radiated signals. It is found that there is only one maximum of the mutual correlation coefficient, the magnitude of which is determined by the Rayleigh parameter P_0 and consequently decreases with increase in unevenness of bottom relief and with an increase in the central frequency of the signal. Figures 4; references 9: 7 Russian, 2 Western.

[35-6508]

USSR

NONLINEAR PERTURBATIONS IN A LIQUID CONTAINING BUBBLES OF GAS

Moscow AKUSTICHESKIY ZHURNAL Vol 25 No 5 Sep/Oct 79 pp 681-685 manuscript received 4 Sep 78; after revision, 16 Jan 79

GASENKO, V. G., NAKORYAKOV, V. YE and SHREYBER, I. R., Institute of Heat Physics, Siberian Division, USSR Academy of Sciences

[Abstract] A study is made of perturbations in a liquid containing gas. The boundaries of the parameters σ and Re at which the qualitative nature of the solutions to the describing equations corresponds to various limiting cases are determined. A diagram is presented of the three-dimensional shapes of the solutions of the Korteweg-DeBriese-Burgers equations in coordinates σ, σ/Re and τ. Three areas of characteristic solutions are found: oscillating "long" waves, Burgers-type solutions and oscillating packets of waves. Figures 2; references 16: 13 Russian, 3 Western.

[35-6508]

USSR

REFLECTION FROM AN OBSTACLE IN A ONE-DIMENSIONAL MEDIUM WITH RANDOM HETEROGENEITY

Moscow AKUSTICHESKIY ZHURNAL Vol 25 No 5 Sep/Oct 79 pp 686-692 manuscript received 20 Nov 78

GEL'FGAT, V. I., Acoustics Institute imeni N. N. Andreyev, USSR Academy of Sciences

[Abstract] An earlier work studied a one-dimensional problem of scattering of a flat monochromatic wave on a layer consiting of a chain of discrete random independent scattering elements with uniformly distributed independent phase coefficients of reflection. This article studies a similar problem on the assumption that at the end of thelayer is a mirror with a known reflection coefficient. The mean energy density and mean field are calculated for this case. Interference of waves in opposite directions is found to influence the distribution of the energy density. It is noted that if there is no mirror, the mean level and phase of the field drop linearly with increasing distance from the source. Figures 3; references 8 Russian.

[35-6508]

USSR

DIFRACTION OF SONIC WAVES ON A SYSTEM OF CYLINDERS LOCATED IN OPEN CIRCULAR LAYERS

Moscow AKUSTICHESKIY ZHURNAL Vol 25 No 5 Sep/Oct 79 pp 717-724 manuscript received 15 Jan 79

KLIMOV, A. YE and LEYKO, A. G.

[Abstract] A study is made of the problem of diffraction of plane sonic waves on a system consisting of a finite number of infinitely long, absolutely rigid circular cylinders, placed in open circular layers of an ideally compliant material of finite thickness. The longitudinal axes of the cylinders are parallel and lie in the same plane. The cylinders and layers have arbitrary cross-sectional dimensions and arbitrary oreintation in space. A strict solution to the problem is derived. The angular distributions of normalized amplitudes of the scattering field of individual cylinders is determined for various angles of incidence of the waves on the system. Figures 3; references 2 Russian.

[35-6508]

USSR

ATTENUATION OF ULTRASONIC WAVES IN LOW-VISCOSITY FLUIDS WITH GAS BUBBLES

Moscow AKUSTICHESKIY ZHURNAL Vol 25 No 5 Sep/Oct 79 pp 725-731 manuscript received 12 Dec 77; after revision, 13 Nov 78

KOL'TSOVA, I. S., KRYNSKIY, L. O., MIKHAYLOV, I. G. and POKROVSKAYA, I. YE., Leningrad State University imeni A. A. Zhdanov, Physics Department, Scientific Research Institute of Physics

[Abstract] An experimental study is described of the coefficient of additional attenuation $\Delta\alpha$ of ultrasonic waves propagating in low-viscosity fluids with gas bubbles in the quasiequilibrium state. Measurements were conducted over a braod range of frequencies at temperatures of 15 and 25° C; the variation of $\Delta\alpha$ with concentration near resonance of the bubbles and in the area beyond resonance was studied. The attenuation factor of the ultrasonic waves was measured by a pulse method. A block diagram of the installation for measurement of the attenuation coefficient is presented, as well as histograms of bubbles and the variation of attenuation coefficient with frequency. Figures 5; references 11: 3 Russian, 8 Western.

[35-6508]

USSR

FACTORING OF A SONIC FIELD BY MEANS OF TWO CONCENTRIC SPHERICAL RECEIVING SURFACES

Moscow AKUSTICHESKIY ZHURNAL Vol 25 No 5 Sep/Oct 79 pp 732-736 manuscript received 9 Jan 79

KONYAYEV, S. I., LEBEDEV, V. I. and FEDORYUK, M. V., Acoustics Institute imeni N. N. Andreyev, USSR Academy of Sciences

[Abstract] The spherical harmonics of a sonic field are determined for the case when the receiving surfaces immersed in a space filled with a homogeneous and isotropic fluid or gas through which the sonic field propagates are two concentric spheres. In this case, the problem of factoring of the total sonic field can be solved exactly. An analysis of the errors which arise is presented. Figures 3; references 4 Russian.

[35-6508]

USSR

MODEL OF THE EXTERNAL NOISE SPECTRUM FOR PURPOSES OF ACOUSTICAL PROBING OF THE ATMOSPHERE

Moscow AKUSTICHESKIY ZHURNAL Vol 25 No 5 Sep/Oct 79 pp 749-753 manuscript received 16 Jun 78; after revision 2 Jan 79

KRASNENKO, N. P. and ODINTSOV, S. L., Institute of Atmospheric Optics, Siberian Division, USSR Academy of Sciences

[Abstract] A model is presented of external noise, i.e., artifically created noise, which hinders the use of sonar devices for probing of the atmosphere, particularly near airports and cities. External noise sources, primarily transportation and industrial activity, are distributed at various angles from the receiver, and the radiation which they produce is both noncoherent and nonmonochromatic. External, or artificial, noise, even in areas with the minimum level, has a density of $3 \cdot 10^{-18}$ W/Hz at 5 kHz, two orders of magnitude higher than the spectral density of internal, or natural, noise. A diagram is presented for determination of the parameters of the model of spectral intensity of external noise for various locations. Figures 2; references 12: 6 Russian, 6 Western.

[35-6508]

USSR

UNRELIABILITY OF ESTIMATION OF COHERENCE ON THE BASIS OF AMPLITUDES OF SIGNALS RERADIATED BY THE SURFACE OF THE SEA

Moscow AKUSTICHESKIY ZHURNAL Vol 25 No 5 Sep/Oct 79 pp 788-790 manuscript received 19 Oct 78

BORODIN, V. V. and KOPYL, YE. A., Acoustics Institute imeni N. N. Andreyev, USSR Academy of Sciences

[Abstract] The coherence of the acoustic field reradiated by the surface of the sea is an important characteristic of the process of dispersal. Experimental studies usually record the amplitude of reradiated signals, then judge the coherence based on the nature of amplitude fluctuations. This is not very reliable. The question arises as to whether there are other simple, but more reliable methods of estimating coherence on the basis of amplitude characteristics. This article yields a negative answer to this question: even an estimate of maximum likelihood, the "optimal" in many senses, is insufficiently reliable in this case. References 6 Russian.

[35-6508]

USSR

CORRELATION METHOD OF MEASUREMENT OF THE COEFFICIENT OF REFLECTION OF SOUND FROM THE BOTTOM AND SURFACE OF THE SEA

Moscow AKUSTICHESKIY ZHURNAL Vol 25 No 5 Sep/Oct 79 pp 793-794 manuscript received 15 Jan 79

KRASNOBOROD'KO, V. V., Acoustics Institute imeni N. N. Andreyev, USSR Academy of Sciences

[Abstract] A coefficient of reflection of sound from the bottom and surface of the sea is usually determined using pulsed-tone radiation. However, measurement can be significantly simplified if one calculates not the function, but rather the coefficient of mutual correlation between the direct and reflected waves, i.e., the mutual correlation function normalized to the square root of the product of the mean intensities of the radiated and received noise signals. This article demonstrates that this normalized factor contains additional information concerning the coefficient of reflection. To illustrate the applicability of the correlation method, a figure shows the mutual correlation coefficient between radiated and received noise signals in the 1600-3200 Hz band with an angle of incidence of 31°. Figure 1; references 5: 3 Russian, 2 Western.

[35-6508]

USSR UDC: 621.315.592

ACOUSTICOELECTRIC EFFECT ON A PIEZOACTIVE WAVE IN TYPE n-GaP, n-AlSb SEMICONDUCTORS

Tomsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY FIZIKA in Russian, No 7 (206), 1979, pp 43-47, manuscript received 22 May 78

LIPNIK, A. A., Chernovitsa Affiliate, Kiev Institue of Trade and Economics

[Abstract] In principle, the theory of acousticoelectronic effects in multiple-valley piezoelectrics should differ from the "single-valley" case. The purpose of this article is to determine the degree of this difference. To do this, the author calcualtes the acousticoelectric current and field, as well as the electron coefficient of absorption and the change in the velocity of sound for a piezoactive sound wave in n-GaP semiconductors. It is found that for any aniosotropy of partial mobility in one valley, the anisotropy $\tilde{\mu}_{\alpha}$ is comparatively small. Therefore, the difference in "heating" of valleys is also small. The conclusion that piezoactive acousticoelectronic effects are nearly independent of the probability of transitions between valleys in n-GaP-type crystals is of heuristic significance, since it extends to a broad range of conditions. References 22: 15 Russian, 7 Western.

[18-6508]

USSR

STUDIES OF THE PHASE OF AN ELECTROACOUSTICAL ECHO

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI Vol 30 No 6 20 Sep 79 pp 324-327 manuscript received 4 Jul 79

YEVTIKHIYEV, N. N., KUKHTIN, R. I. and VENEVTSEV, YU. N., Moscow Institute of Electronics and Automation; Scientific Research Institute of Physics and Technology imeni L. Ya. Karpov

[Abstract] A study is presented of the variation of the phase of a two-pulse dynamic electroacoustical echo arising at moment in time 2τ as a function of the amplitude and duration of the exciting pulses, and the interval between them τ. The mechnism of formation of the elecrroacoustical echo is also determined. Experimental results agree qualitatively with the theoretical predictions based on the amplitude shift of the frequency of oscillations of particles. Figures 3; references 7: 6 Russian, 1 Western.

[37-6508]

USSR UDC: 539.4.25

GENERATION OF ACOUSTIC SPACE WAVES BY NONLINEAR INTERACTION OF BAKCWARD SURFACE WAVES IN A SEMICONDUCTOR-PIEZOELECTRIC STRUCTURE

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 49 No 8, Aug 79
pp 1777-1779 manuscript received 18 Dec 78

BOZHENKO, V. V., LYAMOV V. YE. and SOLODOV, I. YU., Moscow State University imeni M. V. Lomonosov

[Abstract] It is shown for the first time that the interaction of backward acoustic surface waves (ASuW) in composite semiconductor-piezoelectric crystal structures is accompanied by a effective generation of acoustic space waves (ASpW) which can be utilized for acoustic recording of the convolution signal. The necessary and sufficient conditions for the generation of ASpW are formulated, and are experimentally verified for the nonlinear interaction of ASuW with respect to Si-$LiNbO_3$ and CdS-$LiNbO_3$ structures, with oscillographic recording of the output signals. ASpW of 15 MHz frequency were generated in the piezoelectric crystal substrate YZ-$LiNbO_3$ by means of pulsed excitation, on placing a high-resistivity p-type specimen of silicon directly on the surface of lithium niobate. The oscillographically recorded ASpW pulses had a triangular shape and their duration was equal to that of the interacting pulses of ASuW. (The generation of ASpW in the CdS-$LiNbO_3$ structure was somewhat less effective.) The resulting ASpW signal displays all the properties of acoustic convolution, whcih warrants utilizing this effect in acoustoelectronic convolvers. Figures 2; references 6: 2 Russian, 4 Western.

[32-1386]

USSR

GENERATION OF THE INVERSE WAVE AND ACOUSTIC SCANNING IN THE PRESENCE OF NONLINEAR INTERACTIONS OF SURFACE AND SPACE WAVES

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 49 No 9 Sep 79
pp 2008-2010 manuscript received 2 Jan 79

BOZHENKO, V. V., IGNAT'YEV, V. M., LYAMOV, V. YE. and SOLODOV, I. YU., Moscow, State University imeni M. V. Lomonosov

[Abstract] The generation of the inverse acoustic surface wave (ASW) on parametric interaction between a direct wave and an electrical pumping field is potentially applicable to adaptive systems of correlational signal processing. The range of functional transformations in such acousto-electronic devices can be markedly expanded if the "one-dimensional"

electrical pumping signal is replaced with the more informative acoustic variable-space wave. This can be accomplished by streamlining the nonlinear interaction between space and surface waves. In this connection, the generation of an inverse surface wave was experimentally observed in the laminar semiconductor-dielectric structure YZ-$LiNbO_3$-Si upon nonlinear interaction between the direct surface wave propagating along the Z-axis of lithium niobate and a shear wave polarized along Z and oriented along the Y-axis. The signal of that inverse wave represents the cross-correlation function of the interacting signals of the space and acoustic surface waves. Since the effectiveness of this process is sufficiently high, it can be utilized in acoustic correlator systems. Moreover, since the amplitude of the inverse wave generated at some point on the crystal surface is directly proportional to the amplitude of the space wave at that point, the inverse wave contains information on the in-ensity distribution in the acoustic beam at a given time instant, as has been verified with the aid of an oscillograph. Figures 2; references 4: 2 Russian, 2 Western.

[33-1386]

USSR UDC: 548.5

GROWTH OF SINGLE TETRAGONAL CRYSTALS OF HgI_2 FROM THE VAPOR PHASE

Dushanbe DOKLADY AKADEMII NAUK TADZHIKSKOY SSR in Russian Vol 22 No 4, 1979 pp 242-244 manuscript received 26 Feb 79

KOSIMI, S., TURAYEV, U. and KHALIKOV, B., Physicotechnical Institute imeni S. U. Umarov, Tadzhik Academy of Sciences

[Abstract] Single crystals of the red (tetragonal) modification of HgI_2 have interesting optical propeties: lately they have been used to manufacture nuclear radiation counters. Growth of high-quality single crystals suited for manufacture of such devices is difficult because of the high pressure of iodine vapor and the presence of polymorphism in its crystal structure. Mercuric iodide is trimorphic. Single crystals were produced from the vapor phase using static temperature gradients. Initial substance was synthesized in a three-section quartz reactor in an inert gas atmosphere. The first and second sections are evaporation zones of individual components and the third is the HgI_2 condensation zone. This method can be used to produce single crystals weighing up to 50 grams or more, depending on the parameters and conditions of the experiment. These crystals are more perfect than those produced by temperature fluctuation. Figure 1; references 6: 3 Russian, 3 Western.

[1-8617]

USSR

PARAMETRIC EXCITATION OF SOUND IN PARATELLURITE CRYSTALS

Leningrad FIZIKA TVERDOGO TELA V in Russian Vol 21 No 6, Jun 79 pp 1648-1652 manuscript received 24 Jul 78; after editing, 24 Nov 78

IL'CHENKO, L. N. and OBOZNENKO, YU. L, Kiev State University imeni T. G. Shevchenko

[Abstract] Experimental research into parametric generation of sound is generally complicated by the presence of competing proce-ses of the generation of higher harmonics of the pumping wave andof other wave types in nonlinear media, characteristic of work with oscillators. Crystals, in particular, are characterized by a marked variety of values of linear and nonlinear elastic moduli determining the processes of the parametric generation and excitation of higher harmonics. To obviate this difficulty, a case of parametric generation of sound in which virtually no allowance need be made for the generation of higher harmonics is investigated for

tetragonal crystals of paratellurite displaying a marked anisotropy of elastic properties in the [110] orientation: it can hence be expected that parametric interaction occurs in this direction with an effectiveness markedly differing from the effectiveness of the generation of higher harmonics. Abridged equations allowing for parametric excitation of two transverse elastic waves, propagating in opposite directions, by a longitudinal pumping wave are derived. The equations are solved analytically for the case in which attenuation can be disregarded, as well as numerically with allowance for attenuation. Conditions whose satisfaction dispenses with having to allow for the excitation of the second harmonic of the pumping wave are derived. A case of pure three-frequency interaction is experimentally observed in which nearly the entire energy of the longitudinal wave is pumped into the transverse waves. Selfmodulation of the parametrically excited waves, arising when the pumping power is several times as high as its threshold value, is investigated. The frequency dependence of the threshold power is also investigated. Figures 6; references 5 Russian.

[190-1386]

USSR

STATES WITH LOW BINDING ENERGY IN EXTRINSIC MULTI-VALLEY SEMICONDUCTORS PLACED IN A MAGNETIC FIELD

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21, No 6, 1979 pp 1673-1678 manuscript received 11 Dec 78

SAVVINYKH, S. K., Novosibirsk, Institute of Semiconductor Physics, Siberian Affiliate of the USSR Academy of Sciences

[Abstract] Isoelectron dopants in semiconductors may result in the formation of localized electron states with a low binding energy. These states, whose wave functions display a marked spatial extent, may markedly affect the behavior of the crystal and in particular its optical properties. In this connection, these states are investigated at the isoelectron impurity centers in multi-valley semiconductors placed in an external magnetic field, on using the zero-radius potential method. The electron-impurity interaction is specified as a function of the lengths of intra- and intervalley scattering, which express the pseudopotential of the impurity center. The use of the zero-radius potential method makes it possible, owing to its simplicity, to derive the energy spectrum and wave functions of the localized states and to investigate the field and tentative dependences of various parameters of interest to experiment, which should assist in the identification of isoelectron impurities in the crystal. Equations of the energy spectrum of the localized states are derived and the dependence

of the energy levels on the magnitude and orientation of the magnetic field is investigated in elementary extremal cases. Specific calculations are presented for a semiconductor with a Ge-type structure of the lower edge of the construction band. References 7: 2 Russian, 5 Western.

[190-1386]

USSR

MANIFESTATION OF COOPERATIVE JAHN-TELLER EFFECT IN THE ACOUSTIC PROPERTIES OF POLYCRYSTALLINE SPINELS

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21, No 6, 1979 pp 1679-1682
manuscript received 12 Dec 78

BELOV, K. P., VEKHTER, B. G., GORYAGA, A. N., KAPLAN, M. D., MIRZOAKHMEDOV, KH. M., KHROMOVA, N. N. and SHUTILOV, V. A., Leningrad State University imeni A. A. Zhdanov

[Abstract] Although the cooperative Jahn-Teller effect (CJTE) was first discovered in spinels and perovskites, these have previously remained relatively uninvestigated in comparison with such other classes of Jahn-Teller compounds as rare-earth phosphates, vanadates, or arsenates. In this connection, the use of acoustic methods, which are extremely sensitive to changes in crystal structure, as a means of investigating the CJTE in certain polycrystalline spinels was explored. To this end, the velocity and absorption of longitudinal and shear ultrasonic waves (frequency 2.5 megaHz) in annealed powder-metallurgical spinels $NiCr_2O_4$, $Ni^{2+}Fe^{3+}_{0.75}V^{3+}_{1.25}O_4$, and $Fe^{2+}Fe^{3+}_{0.2}\ Cr^{3+}_{1.8}\ O_4$ were measured as function of temperature from -120°C to +100°C. Temperatures corresponding to the structural phase transition due to the CJTE were found to be associated with minima of velocity and maxima of absorption for both these wave types. Hill-method calculations of the temperature dependence of velocity and absorption in the polycrystals, perforemd with allowance for data for the monocrystalline "soft" elasticity modulus ($c_{11}-c_{12}$) were in good agreement with experiment. Figures 4; references 8: 1 Russian, 7 Western.

[190-1386]

USSR

CONCERNING THE ELECTROMAGNETIC EFFECT

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21 No 6, 1979 pp 1695-1701
manuscript received 19 Dec 78

VOLKOV, B. A., KOPAYEV, YU. V. and MOLOTKOV, S. N., Moscow Institute of Physics imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] A microscopic description of the electromagnetic effect in doped antiferromagnetic semiconductors is presented within the framework of the exciton-dielectric model. It is shown that a magnetoelectric effect takes place in a system with purely triplet electron-hole pairing. The application of even a weak electrical field to a crystal results in its magnetization, i.e. in the appearance of ferromagnetism. The application of evan a weak magnetic field results in the polarization of the system, i.e. in tbe appearance of ferroelectric properties in the system. Moreover, if the system is already ferromagnetic, the application of the electrical field will change its magnetization. In real systems of finite dimensions the electrical field due to polarization (the converse effect--the appearance of ferroelectric properties) is shielded by surface charges and hence the internal electrical field can be detected in thin films (having a thickness of the order of the Debye shielding radius). Owing to the shielding of the external electrical field, observation of the direct effect (magnetization) also requies thin films. REferences 10: 8 Russian, 2 Western.

[190-1386]

USSR

ABSORPTION OF ULTRASOUND AT TEMPERATURES OF 4.2-77 K IN YTTRIUM-ALUMINUM GARNETS DOPED WITH RARE EARTH METALS

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21 No 6, 1979 pp 1710-1714
manuscript received 29 Dec 78

AKHMETOV, S. F., IVANOV, S. N. and MEDVED', V. V., Moscow Institute of Radio Engineering and Electronics, USSR Academy of Sciences

[Abstract] The system of energy levels arising in yttrium-aluminum garnets (YAG) doped with rate-earth metals (REM) was investigated by the acoustic method. The investigation was performed in the 4.2-80 K temperature range and in the 1-9.4 GHz frequency range on specimens doped in accordance with the formula $Y_{3-x}Ln_xAl_5O_{12}$, where Lnl.5Tb, Dy, Er, Tm, and

Yb. The amount of REM added varied from $x = 0.05$ to $x = 0.3$. Attenuation of the ultrasound was measured by the pulsed echo method. Longitudinal ultrasound waves were excited with the aid of film-type texturized cadmiumsulfide and zinc-oxide piezoelectric transducers. "Peaks" of ultrasound absorption characteristic of the inroduction of dopants with unfilled outer or inner electron shells into the crystal lattice were discovered. The findings on sound absorption are interpreted on the basis of the relaxation model with characteristic relaxation times determined by orbach processes. The energy positions of the levels determining the absorption processes are determined, as are the characteristic relaxation times and the parameters of spin-phonon coupling. Figures 3; references 11 Western.

[190-1386]

USSR
PROTON MODES IN KDP CRYSTALS

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21 No 6, 1979 pp 1715-1718 manuscript received 30 Dec 78

VOLKOV, A. A., KOZLOV, G. V. and LEBEDEV, S. P., Moscow, Physics Institute imeni N. P. Lebedev, USSR Academy of Sciences

[Abstract] The dielectric spectra of strongly deuterated KDP crystals were investigated in the $E \parallel a$ orientation by the monochromatic submillimeter spectroscopy method at 5-12 cm^{-1} frequencies. The existence of a temperature-dependent mode in these crystals, responsible for the observed variance of dielectric permittivity, was established. This mode was termed ω_κ to distinguish it from the mode ω_σ which appears for $E \parallel c$. The fact that both these temprature-dependent modes disappear in the ferroelectric phase and also the dependence of their frequencies on the extent of deuteration of the crystals indicate that they are associated with excitations of the proton subsystem. When one proton is located in the neightborhood of one of the upper oxygen atoms which together with the lower atoms form a tetrahedron, and the other, at a lower oxygen atom, the resulting oscillation of symmetry E is IR-active and thus the dielectric spectra in the $E \perp c$ orientation contain direct information on the movement of hydrogen-bond protons. While mode ω_κ in itself does not represent an antiferroelectric soft wave, its frequency in crystals of the KDP family coincides with the frequency of that wave and thus serves as a means of assessing the dynamice of antiferroelectric excitations of proton sybsystems. Figures 2; references 14: 2 Russian, 12 Western.

[190-1386]

USSR

MODULATIONAL OSCILLATIONS IN HIGH-PERMITTIVITY CRYSTALS

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21 No 6, 1979 pp 1782-1784
manuscript received 4 Oct 78; after editing, 19 Jan 79

VIGDORCHIK, N. YE., Leningrad TEchnological Institute imeni Lensovet

[Abstract] Modulational oscillations of electromagnetic waves in solid dielectrics are investigated. It is shown that modulations of a traveling electromagnetic wave result in variation in the spectrum of the longitudinal sound wave owing to interaction between the electromagnetic wave and lattice vibrations. The propagation of nonlinear stationary electroacoustic waves in dielectrics also is investigated. Corresponding formulas are derived from Maxwell equations and from equations of lattice vibrations with allowance for electrostriction. It is shown that renormalization of the speed of sound in dielectrics can be achieved by either applying a constant electrical field or passing a modulated electromagnetic wave through the crystal. The possibility of existence of nonlinear solitary waves ("envelope solitons") in dielectrics is demonstrated and it is shown that in such cases the solitons beong in the acoustic class. References 8: all Russian.

[190-1386]

USSR

AFTERREFFECT IN GAMMA-IRRADIATED NaCl and KCl CRYSTALS

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21 No 6, 1979 pp 1785-1789
manuscript received 19 Jan 79

KOROVKIN, YE. V., Chernogolovka (Noginskiy Rayon, Moskovskaya Oblast), Institute of Solid-state Physics, USSR Academy of Sciences

[Abstract] The existence of an aftereffect was discovered and investigated in KCl and NaCl crystals subjected to gamma-irradiation (dose $\lesssim 5 \cdot 10^6 - 10^7$ rad). On this basis it was concluded that the color centers responsible for the photoplastic effect (PPE) and generated by the F-light pulse have a lengthy lifetime. Investigation of the aftereffect by the internal friction method confirmed the theory that it is due to light-induced excitations in the crystal which impede the movement of dislocations and have a lifespan of about one minute. By contrast with the kinetics of the aftereffect established earlier for A^2B^6, however, its kinetics in alkali-halide crystals proved to be markedly dependent on the rate of plastic deformation and

weakly dependent on temperature within the investigated temperature range (170-300 K). Figures 4; references 3: 2 Russian, 1 Western.

[190-1386]

USSR

THE NONCENTRAL JAHN-TELLER ION: LOCALIZATION AT THE ENERGY MINIMUM WITH C_1 SYMMETRY

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 21 No 6, 1979 pp 1789-1797 manuscript received 20 Jan 79

VIKHNIN, V. S., SOCHAVA, L. S. and TOLPAROV, YU. N., Leningrad, Physico-Technical Institute imeni A. F., Ioffe, USSR Academy of Sciences

[Abstract] Noncentral Jahn-Teller ions are ions whose surroundings are simultaneously subject to polar deformation (associated with noncentrality) and tetragonal Jahn-Teller deformation. The simultaneous effect of these two deformations on an impurity center is now investigated. To this end, the EPR spectrum of Ni+ ions in SrO was investigated over a broad range of temperatures (from 4.2 to 350 K) as well as upon applying a constant electrical field ($\leq 4 \cdot 10^5$ watt/cm) to the specimen. It was established that the point group of symmetry of the paramagnetic center is C_1. As the temperature is increased, the spectrum is subject to double averaging owing to motion: at $T_1 = 95$ K its symmetry increases to C_s and at $T_2 = 212$ K, to C_{2v}. The paramagnetic center is associated with the electrical dipole moment ρ lying in the $\{110\}$ plane of the crystal and capable of orienting itself only in two ways (ρ_1 and ρ_2). The vector $\Delta\rho = \rho_1 - \rho_2$ is parallel to the z-axis of the paramagnetic center, corresponding to the minimum-anisotropy orientation of the g-factor: $\Delta p = 9.6 \pm 1.2$) D. Models of the noncentral Jahn-Teller ion in which connected dipole-active and Jahn-Teller deformations occur are discussed. Manifestations of a new type of multiple-well potential XY_{24} of the noncentral ion are examined. It is shown that use of the models of the noncentral Jahn-Teller ion in which allowance is made for the interaction between dipole-active deformations caused by the ion mechanism of noncentrality and tetragonal Jahn-Teller deformations makes it possible, on taking the fourth-order anharmonicity into account, to account for theexperimental findings on Ni+ in SrO, since then they are in agreement with the resultant symmetry of the Jahn-Teller center located in one of the wells of the XY_8 potential. Figures 5; references 15: 7 Russian, 8 Western.

[190-1386]

USSR

CYCLOTRON RESONANCE ON SLIDING ELECTRONS AND DETERMINATION OF THE PARAMETERS OF INTERELECTRON INTERACTION IN BISMUTH

Leningrad FIZIKA TVERDOGO TELA in Russian, Vol 21, No 5, May 79, pp 1300-1306, manuscript received 24 Oct 78

SILIN, V. P., TOLKACHEV, O. M., Institute of Physics imeni P. N. Lebedev USSR Academy of Sciences, Moscow

[Abstract] A method is suggested which leads to the determination of effects of "interellipsoidal" interaction, based on an earlier development of the theory of cyclotron resonance on sliding orbits of surface electrons in the electron fluid of metals and semimetals. In order to assure the most precise possible comparison of theoretical and experimental data, the discussion is based on data describing the Fermi surface of bismuth. It is clearly demonstrated that the theory requires the performance of both precise measurements and the study of cyclotron resonance. It is emphasized that the accuracy of measurement of earlier works is quite sufficient for ordinary electron Fermi-surface radiation, however, it is only when the interelectron interactions must be determined that this accuracy must be increased. Figure 1; references 8: 7 Russian, 1 Western.

[184-6508]

USSR

ANISOTROPY AND PROPERTIES OF SYMMETRY OF HYSTERESIS PHENOMENA IN THE POLARIZATION OF THE LUMINESCENCE OF A LIGHT-MAGNETIZED SEMICONDUCTOR

Leningrad FIZIKA TVERDOGO TELA in Russian, Vol 21, No 5, May 79, pp 1321-1325, manuscript received 11 Nov 78

DZHIOYEV, R. I., MERKULOV, I. A., NOVIKOV, V. A. and FLEYSHER, V. G., Institute of Physics and Technology imeni A. F. Ioffe, USSR Academy of Sciences, Leningrad

[Abstract] Results are presented from an experimental study of the optical orientation effect under conditions such that antiintersection of nuclear levels should occur. Orientation was created by circularly polarized light directed along a 4th-order [001] axis. The transverse magnetic field is found to carry not only strong angular anisotropy of the effect of the optical orientation, but also invariance of this effect relative to inversion of the sign of circular polarization of the

exciting light. This effect is a manifestation of the nonequilibrium nature of optical orientation with crystal anisotropy. The limitations which crystal symmetry place on the anisotropy of the effect of optical orientation in a magnetic field are analyzed. In order to confirm the possibility of appearance of an electron field, experiments were performed on optical detection of NMR upon pumping with left- and right-circularly polarized light. Figures 3; references 8 Russian.

[184-6508]

USSR

A MICROSCOPIC MODEL OF LOW TEMPERATURE ANOMALIES IN DIELECTRIC GLASSES

Leningrad FIZIKA TVERDOGO TELA in Russian, Vol 21, No 5, May 79, pp 1444-1450, manuscript received 11 Sep 78; in final form, 21 Dec 78

CHABAN, I. A., Institute of Acoustics, Moscow

[Abstract] It was expected that crystals and glass would act similarly at 0.1-1 K, with heat capacity and conductivity decreasing as T^3. It was surprisingly found that glasses do not act like crystals at low temperatures and, still more surprisingly, that all dielectric glasses act in the same manner, with heat capacity increasing as T, heat conductivity as T^2. It was also found that dielectric glasses act unusually in the propagation of sonic, shear and electromagnetic waves. Several models have been suggested to attempt to explain these pecularities. The model which seems most reasonable assumes that the glass contains atoms or groups of atoms which can be in 2 positions: either in one potential hole or in another, separated from the first by a potential barrier. However, this model also has several difficulties, indicating that glasses contain sets of some sort of 2-level systems with broad distribution of splitting energies. This work studies the nature of these 2-level systems. Figures 2; references 34: 12 Russian, 22 Western.

[184-6508]

USSR

MICROWAVE CONDUCTIVITY ON PHASE TRANSITION TO THE EXCITON PHASE

Leningrad FIZIKA TVERDOGO TELA in Russian, Vol 21, No 5, May 79, pp 1541-1544, manuscript received 16 Oct 78; in final form, 11 Jan 79

IDLIS, B. G., Institute of Spectroscopy, USSR Academy of Sciences,
Academic Village, Podol'skiy Rayon, Moscow Oblast

[Abstract] Interest in the study of various kinetic properties of systems with electron-hole coupling has been increasing. Earlier works have shown that at various amplitudes of scattering of electrons and holes on impurities, the thermo-emf may have a maximum lower than T_c. It is assumed that electrical and heat conductivity remain monotonic in this case. This article demonstrates that in the case of unequal masses of electrons and holes, the microwave conductivity of the exciton phase may have a maximum lower than T_c. Figure 1; references 15: 9 Russian, 6 Western.

[184-6508]

USSR UDC: 621.317.799

INVESTIGATION OF THE FEASIBILITY OF SEPARATE MEASUREMENT OF THE PARAMETERS OF SEMICONDUCTOR LAMINAR STRUCTURES IN A TRANSMITTED MICROWAVE SIGNAL

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR, SERIYA FIZICHESKIKH I TEKHNICHESKIKH NAUK in Russian No 3, 1979 pp 62-69 manuscript received 22 Sep 78

GAVRILIN, V. V., GRIGULIS, YU. K., PORIS, U. R. and RUSMANIS, S. YU.,
Power Engineering Physics Institute, Academy of Sciences LithSSR

[Abstract] The development of semiconductor devices requires reliable methods of checking the parameters of materials used. Noncontact electromagnetic microwave methods of inspection can be used for separately checking several parameters at the same time. The simplest of these methods involve measurement of the parameters of a microwave signal transmitted and reflected by the specimen. In this paper an investigation is made of the feasibility of separate measurement of thickness and resistivity of a semiconductor layer in one-parameter and two-parameter inspection based on analysis of an expression for the complex power factor of electromagnetic wave transmission by the specimen. It is found that simultaneous two-parameter checking of resistivity and thickness is possible with respect

to the phase and modulus of the wave transmission factor. It is shown that one-parameter separate checking of thickness and resistivity with respect to the phase or modulus of the transmision factor is possible with some detuning from the variation of one of the parameters around the nominal value. A technique is proposed for using real waveguide systems in separate measurement of the phase and modulus of the transmission factor. A block diagram is given of a facility for separate two-parameter measurements of the phase and modulus of the transmission factor. Figures 7; references 6 Russian.

[7-6610]

USSR UDC: 535.373.2

LUMINESCENCE AND STIMULATED EMISSION OF COLOR CENTERS IN LiF

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA FIZICHESKAYA in Russian Vol 43, No 6, Jun 79 pp 1125-1132

PARFIANOVICH, I. A., KHULUGUROV, V. M., LOBANOV, B. D. and MAKSIMOVA, M. T., Scientific Research Institute of Applied Physics at Irkutsk State University imeni A. A. Zhdanov

[Abstract] One of the disadvantages of LiF lasers is thermal and optical instability of active color centers that fluoresce at room temperature. The authors investigate this problem on LiF crystals doped with Li_2O, LiOH, MgF_2, NiF_2 and TiF_4. The color centers were induced by gamma and x-rays. The analysis was based on optical absorption and luminescence, and high optical and thermal stability in LiF-OH and LiF-Li_2O. Lasers based on these crystals were studied with ruby laser pumping. The results of these studies were used in developing laser materials based on NaF single crystals. It is found that active laser media with optically and thermally stable color centers that fluoresce at room temperature in the near infrared can be made by proper selection of the activating dopant to alter the luminescence properties of crystals. Figures 4; references 34: 17 Russian, 1 Polisy, 16 Western.

[10-6610]

USSR UDC: 535.372

LUMINESCENCE OF ION-DOPED PHOSPHOR CRYSTALS OF GROUP $A^{II}B^{VI}$

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA FIZICHESKAYA in Russian
Vol 43, No 6, Jun 79 pp 1179-1185

GEORGOBIANI, A. N. and KOTLYAREVSKIY, M. B., Physics Institute imeni
P. N. Lebedev, Academy of Sciences USSR

[Abstract] An examination is made of $A^{II}B^{IV}$ compounds (exemplified by ZnS) in which the forbidden band has a width of the order of 2.5 eV or more, as potential candidates for making light-emitting diodes with green, blue and ultraviolet output. Ionic doping of ZnS crystals with zinc and sulfur is studied, and it is shown that the method of ionic doping is an effective means of controlling the defect structure of wide-band compounds of this type, suppressing self-compensation of defects, and also controlling the type and magnitude of conductivity. Activation by this type of doping can be used to produce electroluminescent p-n junctions in $A^{II}B^{IV}$ crystals for opto-electronic devices. Figures 5; references 24: 11 Russian, 1 Czech, 12 Western.

[10-6610]

USSR UDC: 537.226.33:536.424.1:539.2

POSSIBLE PURELY FERROELASTIC PHASE TRANSITION BETWEEN THE RHOMBIC PARA PHASE AND THE MONOCLINIC SEIGNETTE PHASE AND ANALYSIS OF THEIR DIFFERENCES

Moscow IZVESTIYA AKADEMII NAUK SSSR SERIYA FIZICHESKAYA in Russian, Vol 43
No 8, 1979, pp 1619-1630

SHUVALOV, L. A. and LEVITANSKIY, YU. I., Institute of Crystallography
imeni A. V. Shubinkov, USSR Academy of Sciences, Scientific Research
Institute of Physics, Rostov-na-Donu State University

[Abstract] This entire issue of this journal reports the proceedings of a conference on ferroelastics (crystals in which the phase transition to the ferroelastic phase is accompanied by a change in the thermal expansion tensor components, forbidden by symmetry of the para phase). If the macroscopic spontaneous deformation which occurs can be used as a parameter of the transition, the transition is called a proper ferroelastic transition, otherwise it is called an improper ferroelastic transition. If the change in point symmetry of the crystal upon transition is described by spontaneous deformation alone (spontaneous polarization does not develop), the transition is a purely ferroelastic transition. The analysis

in this article shows that for improper ferroelastic phase transitions, the temperature specifics of the susceptibilities and other physical characteristics depend essentially on the transformation properties of the transition parameter. All possible phase transitions between the initial phase with D_{2h} symmetry and the ferroelastic phase with C_{2h} symmetry are used to analyze differences in proper and various types of improper purely ferroelastic phase transitions, and the possibilities of using the results both for prediction of the nature of anomalies in elastic and dielectric properties of crystals upon transition and for determination of the spatial group of symmetry of phases are discussed. Figure 1; references 13: 8 Russian, 5 Western.

[21-6508]

USSR UDC: 537.226.33:535.375.5:539.2

OPTICAL PHONONS AND MILD MODES IN THE FERROELASTIC $KFe(MoO_4)2$

Moscow IZVESTIYA AKADEMII NAUK SSSR SERIYA FIZICHESKAYA in Russian, Vol 43, No 8, 1979 pp 1650-1657

SMOLENSKIY, G. A., SINIY, I. G., KUZ'MINOV, YE. G., and DUDNIK, YE. F., Institute of Physics and TEchnology imeni A. F. Ioffe, USSR Academy of Sciences, Dnepropetrovsk State University

[Abstract] To bring order to the confusion around the question of the symmetry of phases of KFe(Mo04)2, the authors undertook a study of the crystal by various methods. In this article, results are presented on measurement of the Raman scattering of light in KFe(Mo04)2. Raman scattering in KFe(Mo04)2 is interesting because it may generate information on the spectrum of oscillations of the lattice of binary molybdates, may yield new data on the relative symmetry of the phases produced, may allow study of the dynamics of the scattering of the crystals upon phase transformations and may provide new results on binary molybdates, comparable to phenomena in other crystals. The experimental results in fact agree well with the group theory calculation for the group D^3_{3d}. An additional phase transition of the first kind $T_2 = 139$ K is found. The behavior of the spectrum of vibrations of thelattice and a number of other results show that the transition occurs probably with a change in the spatial group within thelimits of monoclinic syngony from C^6_{2h} to C^3_{2h}. Figures 6; references 14: 10 Russian, 4 Western.

[21-6508]

USSR UDC: 537.226.33: 535.375.
5:539.2

SCATTERING OF LIGHT IN TRISARCOSINE CALCIUM CHLORIDE

Moscow IZVESTIYA AKADEMII NAUK SSSR SERIYA FIZICHESKAYA in Russian, Vol 43, No 8, 1979, pp 1664-1669

SMOLENSKIY, G. A., SINIY, I. G., ARNDT, H., PROKHOROVA, S. D., KUD'MINOV, YE. G., MIKVABIYA, V. D. and KOLPAKOVA, N. N., Institute of Physics and Technology imeni A. F. Ioffe, USSR Academy of Sciences, Martin Luther University, Halle, German Democratic Republic

[Abstract] It was recently found that crystals of ammonium sulphate and trisarcosine calcium chloride have ferroelastic properties at temperatures above T_C (223 K for AS and 125 K for TSCC). This article studies the dynamics of the AS and TSCC lattices upon phase transition to ferroelastic ordering. Studies of light scattering in TSCC reveal anomalies in the behavior of a number of optical and acoustical phonons upon this transition without a center of inversion. Most interesting is the distance of a soft $A_1(Y)$ (TO) phonon, the frequency of which approaches 0 as T_S is approached from lower temperatures. Figures 4; references 15: 2 Russian, 13 Western.

[21-6508]

USSR UDC: 537.226:534.28:539.21

INFLUENCE OF ISOTOPE SUBSTITUTION AT THE HYDROGEN ON ABSORPTION OF SOUND DURING THE FERROELASTIC PHASE TRANSITION IN A CRYSTAL $KH_3(SeO_3)_2$

Moscow IZVESTIYA AKADEMII NAUK SSSR SERIYA FIZICHESKAYA in Russian, Vol 43, No 8, 1979, pp 1702-1705

KESSENIKH, G. G., QUYNH, T. V. and SHMIDT, G., Institute of Crystallography imeni A. V. Shubnikov, USSR Academy of Sciences, Martin Luther University, Halle, German Democratic Republic

[Abstract] A theoretical analysis is presented of earlier experiments on the studies of the anomalies of absorption and velocity of propagation of sound waves in ferroelastic crystals, in order to determine the influence of isotopic substitution at the hydrogen on relaxation processes during the ferroelastic phase transition. The crystals studied experienced a ferroelastic base transition $mmm \rightarrow 2/m$ in which spontaneous deformation u^s_{xz} occurs in the ferroelastic phase. The authors consider that the phase transition in question is a pseudo-transition and present an equation for

the thermodynamic potential. The effective time constant of relaxation is calculated from the experimental values at various temperatures, indicating that the absorption of sound in the case in question results primarily from acoustical relaxation which is slower than the relaxation of the system of hydrogen bonds. Figure 1; references 16: 8 Russian, 8 Western.

[21-6508]

USSR UDC: 537.228.1

SOME THERMODYNAMIC CHARACTERISTICS OF CRYSTALS OF $KH_3(SeO)_3$ AND $KD_3(SeO)_2$, DETERMINED FROM INFRALOW FREQUENCY MEASUREMENTS OF THE SHEAR MODULUS

Moscow IZVESTIYA AKADEMII NAUK SSSR SERIYA FIZICHESKAYA in Russian, Vol 43, No 8, 1979, pp 1713-1717

GRIDNEV, S. A., DARINSKIY, B. M., PRASOLOV, B. N., SHUVALOV, K. A., and FEDOSYUK, R. M., Voronezh Polytechnical Institute, Institute of Crystallography imeni A. V. Shubinkov, USSR Academy of Sciences

[Abstract] A comparative analysis is presented of the behavior of elastic properties of crystals KHS and KDS in the vicinity of the T_c phase transition at frequencies of 1 to 10 Hz. The crystals were grown from supersaturated aqueous solutions by decreasing the temperature from 42°C at 0.1°C every 3 days. The crystals grew at about 1.5 mm per day. The shear modulus in single-domain crystals shows strong anisotropy. In multiple-domain specimens, the shear modulus acts differently in KHS and in KDS. The appearance of a difference between the temperature of phase transition and the Curie-Weiss temperature in deuterated crystals indicates that deuteration of the KHS crystals slightly changes the nature of thephase transition, shifting it in the direction of a first order phase transition. The temperature variation of c55 near T_C is shown for KHS and KDS. Figures 3; references 11: 8 Russian, 3 Western.

[21-6508]

USSR UDC: 537.226.2:539.21

DISPERSION OF THE BISSECTRIX IN CRYSTALS OF POTASSIUM TRIHYDROSELENITE AND TRIGLYCINSULFATE AT SUBMILLIMETER WAVE LENGTHS

Moscow IZVESTIYA AKADEMII NAUK SSSR SERIYA FIZICHESKAYA in Russian, Vol 43, No 8, 1979 pp 1726-1729

VOLKOV, A. A., KOZLOV, G. V., CHERNYSHEV, I. M. and SHUVALOV, L. A., Institute of Physics imeni P. N. Lebedev, USSR Academy of Sciences, Institute of Crystallography imeni A. V. Shubinkov, USSR Academy of Sciences

[Abstract] This work is the first study of the dispersion of the bissectrix in the submillimeter wave band on the examples of crystals which undergo phase transitions. KHS crystals were studied, with ferroelastic phase transition at $T_c = -62$ C, as well as TGS crystals with ferroelectric phase transition at 49°C. The angles of rotation of the bissectrix of the optical axes as functions of temperature are presented. The value of angle φ is significantly greater in KHS than in TGS. A study of the dispersion of the bissectrix yields information on the electrooptical properties of low-symmetry crystals in the submillimeter wave band. Figures 4; references 6: 5 Russian, 1 Western.

[21-6508]

USSR UDC: 537.226.33:539.27

INFLUENCE OF ELECTRIC FIELD ON DOMAIN STRUCTURE OF KD_2PO_4 (NEUTRON DIFFRACTION DATA)

Moscow IZVESTIYA AKADEMII NAUK SSSR SERIYA FIZICHESKAYA in Russian, Vol 43, No 8, 1979 pp 1740-1744

BALAGUROV, A. M., DATT, I. D., SAVENKO, B. N. and SHUVALOV, L. A., Joint Institute of Nuclear Research, Moscow Institute of Chemical Technology imeni D. I. Mendeleyev, Institute of Crystallography imeni A. V. Shubinkov, USSR Academy of Sciences

[Abstract] Results are presented from studies of the domain structure of DKDP crystals when a static electric field is applied to them. Quantitative and qualitative estimates of the effects of the field on the crystal are based on analysis of the diffraction picture obtained from a specimen--changes in the positions and intensities of Bragg diffraction peaks as a function of the electric field applied to the specimen. The variation and measured intensities of the components of the diffraction peak with applied electric field are shown for components arbitrarily

called the central, left and right components. Apparently, the increase in intensity of the (220)-(660) peaks with increasing field at $E < 4.5$ kV·cm^{-1} is related to an increase in the effective mosaic nature of the crystal, with a consequent decrease in the secondary extinction. In the region where $E \simeq E_c$, considerable restructuring of the domain structure of the crystal occurs, so that the $\pm P_s$-domains of configurations A simultaneously and almost completely disappear and the volume occupied by domains which diffract to produce the central component increases. The deformation, calculated from the displacement of the left and right components of the peak is equivalent to rotation of plane (110) by an angle of approximately ±3' at $E \simeq 8$ kV·cm^{-1}. Figures 3, references 13: 4 Russian, 9 Western.

[21-6508]

USSR UDC: 658.552.24:666.232.2

PROBLEMS OF THE SYNTHESIS AND NEW APPLICATIONS OF SHAPED SAPPHIRES

Moscow IZVESTIAY AKADEMII NAUK SSSR, SERIYA FIZICHESKAYA in Russian Vol 43 No 9, 1979 pp 1944-1946

DOBROVINSKAYA, YE. R., LITVINOV, L. A. and PISHCHIK, V. V., All-Union Scientific Research Institute of Single Crystals

[Abstract] Various modifications of the Stepanov sapphire synthesis method are described: all are based on the use of metal crucibles with a shaping tool. Induction heating is themost expedient technique, since then the consumption of refractories is reduced, and the thyristor converter is the most practical for this purpose. Productivity can be increased by growing crystals of greater length and using caroussel-type drawing mechanisms. The range of new applications of synthetic sapphires is increasing, now that they can be produced on an industrial scale. Thus, the use of sapphire cylinders for solid-state laser pumping devices reduces the threshold lasing energy and prolongs operating life. Sapphire thermocouple housings for temperature controllers operating at high temperatures display a low thermal inertia and contribute to a higher precision of control owing to the transparency of sapphire. Sapphire cylinders for gas lasers display a superior retention of helium compared with quartz cylinders. Sapphire insulators of high-resistance leads assure a minimum diffusion of charge from the surface, only about one-tenth as high as that assured by amber. Atomic hydrogen sources based on the use of a sapphire electrodeless-discharge chamber have a longer service life than those based on quartz chambers. Sapphires also have proved their worth in the design of organic-compound lasers with coherent pumping, cathodoluminescent coaxial lamps, level gauges for hot fluoride melts, and others. Currently, more than 20 different types of sapphire shapes are being produced. Figure 1; references 2: 1 Russian, 1 Western.

[17-1386]

USSR UDC: 548.55

EQUIPMENT FOR GROWING SHAPED SAPPHIRE CYRSTALS BY THE STEPANOV METHOD

Moscow IZVESTIYA AKADEMII NAUK SSSR SERIYA FIZICHESKAYA in Russian Vol 43 No 9, 1979 pp 1947-1952

YEGOROV, L. P., ZATULOVSKIY, L. M., KRAVETSKIY, D. YA., PEL'TS, B. B., FREYMAN, YE. A., CHAYKIN, P. M. and BEREZINA, I. Ye., All-Union Scientific Research Institute of Electrothermal Equipment

[Abstract] The equipment used to grow shaped sapphire crystals by the Stepanov method was investigated with the object of optimizing its design so as to enhance the stability and reproducibility of crystal shaping and broaden the variety and improve the quality of the crystals synthesized. It is found that the temperature of the crucible bottom should not exceed 2090°C and the current frequency of the inductor should best be 8000 Hz so as to increase eithtfold the depth of penetration of the current into the muffle, and to assure an optimal temperature field. Considering that the fluxes of inert gas due to natural convection affect markedly the temperature field and mass transport, a provision should be made for shunting channels to divert the ascending fluxes of heated gas so as to reduce the pollution of sapphire by the impurities carried by the gas following its passage across the heating zone. When groups of crystals are grown instead of a single crystal, the time stabilization of the temperature field is much more complicated, and hence a special automatic temperature control system has been designed for this purpose. The thus optimized equipment has been used to grow sapphire crystals of various shapes inscribed within a circumference of from 2 to 40 mm, as well as shaped crystals of ruby, alexandrite, and yttrium-aluminum garnet. In addition, for the first time, shaped single crystals of scandium oxide were grown. Figures 3; references 8: 5 Russian, 3 Western.

[17-1386]

USSR UDC: 548.55

SYNTHESIS OF SAPPHIE TUBES FROM THE MELT BY THE STEPANOV METHOD AND THE INVESTIGATION OF THEIR PROPERTIES AS WELL AS THEIR UTILIZATION IN THE PRODUCTION OF HIGH-PRESSURE SODIUM LAMPS

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA FIZIVHESKAYA in Russian Vol 43 No 9, 1979 pp 1953-1962

AZOYAN, S. YE., YEGOROV, L. P., ZATULOVSKIY, L. M., KOPETSKIY, CH. V., KOSTANDYAN, K. A., KRAVETSKIY, D. YA., PEL'TS, B. B., RED'KIN, B. S., TATARCHENKO, V. A., TUMASYAN, B. A., CHAYKIN, P. M. and YALOVETS, T. N., All Union Scientific Research Institue of Electrothermal Equipment; Institute of Solid State Physics, USSR Academy of Sciences

[Abstract] High-pressure sodium lamps are currently the most effective sources of public exterior illumination. The principal element of these lamps is a hermetically sealed tube within which an electrical discharge between niobium electrodes is maintained in sodium vapors. The material of that tube should be transparent, withstand up to 1300°C, and not interact with sodium vapors. Normally such tubes are fabricated from sintered aluminum oxide but, considering that then their gabrication entails more than 20 labor-consuming operations and requires intricate precision equipment, the possibility of producing these tubes from single crystal aluminum oxide (leucosapphire) was investigated. The tubes were grown in groups of 6 each with the aid of shaping elements positioned 24 mm above the melt level in the crucible. They were then annealed and used in the manufacture of 250-, 400-, and 1000-watt high-pressure sodium lamps with a luminous efficiency of up to 120 lumen-watt and a service life exceeding 12,000 hr. Information on morphological features, block structure, and the stresses and impurities present in the tubes is presented. Figures 6; references 5: 3 Russian, 2 Western.

[17-1386]

USSR UDC: 548.552.2:666.232.2

INVESTIGATION OF THE THERMAL CONDITIONS OF THE GROWING OF SINGLE-CRYSTAL SAPPHIRE TUBES

Moscow IZVESTIAY AKADEMII NAUK SSSR, SERIYA FIZICHESKAYA in Russian Vol 43 No 9, 1979 pp 1963-1966

TIMAN, B. L., KOLOTIY, O. D., DOBROVINSKAYA, YE. R., PISHCHIK, V. V. and LITVINOV, L. A., All-Union Scientific Research Institute of Single Crystals

[Abstract] The thermoelastic stresses and temperature fields associated with the growing of sapphire crystal tubes by the Stepanov method were investigated. A time-independent one-dimensional equation of the thermal field of a cylindrical tube of averaged thickness was derived and the problem of thermoelasticity was solved for a thin cylindrical envelope; on this basis, stress components were obtained. It is shwon that stresses in the tubes increase with increase in the crystal growth rate. Given the same wall thickness, increasing the drawing rate from 10 to 140 mm·jr^{-1} does not markedly affect the residual stresses, which then remain within the 70-150 kg·cm^{-2} range. Analysis of the dislocation structure of the grown crystals points to the existence of a correlation between the magnitude of residula stresses and the dislocations density. Increasing the tube radius from 0.3 to 4.5 cm causes the dislocation density to slightly increase from $2\cdot10^5$ to $8\cdot10^5$ cm^{-2}, whereas tripling the wall thickness causes the dislocation density to increase from $2\cdot10^5$ to $1.2\cdot10^6$ cm^{-2}. These experimental findings are in agreement with theory. References 9: 8 Russian, 1 Western.

[17-1386]

USSR UDC: 548.552.2:666.232.2

STRUCTURAL INHOMOGENEITY OF SHAPED SAPPHIRE

Moscow IZVESTIYA AKADEMII NAUK USSR, SERIYA FIZICHESKAYA in Russian Vol 43 No 9, 1979 pp 1967-1969

BELAYA, A. N., DOBROVINSKAYA, YE. R., ZVYAGINTSEVA, I. F., LITVINOV, L. A. and PISHCHIK, V. V., All-Union Scientific Research Institute of Single Crystals

[Abstract] Shaped synthetic sapphire crystals grown by the Stepanov method display an extremely non-uniform distribution of density dislocations. In this connection, the non-uniformity of distribution of impurities, was investigated, as was the correlation between impurity distribution and dislocation density with change in growth rate, temperature gradient, and impurity concentration in the crystal. Chromium was used as the dopant. Three types of impurity banding were identified: macrobanding with 0.5-1.5 mm period, microbanding with 20-50 μm period, and ultramicrobanding with 0.05-0.1 μm period. The distribution of the chromium impurity in the crystals also was extremely non-uniform. No correlation could be established between the non-uniformity of impurity distribution and non-uniformity of structure. The presence of cluster-type defects is indicated by microphotographs. Unlike the crystals grown by the Verneuil and Czochralski methods as well as by the oriented crystallization method, the crystals grown by the Stepanov method, when selectively pickled, display an explicit formation of slip bands as well as distinctive twin interlayers. This is due to the thermal shock which the Stepanov crystals undergo when grown in the presence of considerable axial temperature gradients and at fast growing rates. Figures 3; references 3: all Russian.

[17-1386]

USSR UDC: 548.552.2.

CYLINDRICAL PORES IN A GROWING CRYSTAL

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA FIZICHESKAYA in Russian Vol 43 No 9, 1979 pp 1971-1976

ZHDANOV, A. V., SATUNKIN, G. A., TATARCHENKO, V. A. and TAL'YANSKAYA, N. N., Institute of Solid State Physics, USSR Academy of Sciences

[Abstract] The conditions of the appearance of and steady growth of extended cylindrical pores in a growing crystal are examined on the basis of numerical calculations with respect to the porosity of shaped synthetic sapphire crystals. The front of the growing crystal is likened to a filter across which the melt is absorbed and which assures constance of the flow of the melt at right angles to that surface. On this basis, the conditions for the appearance of a cylindrical pore axially extended along the crystal are formulated with respect to the entrapment of a gas-filled bubble from the melt. It is shown that the diameter of the cylindrical pore increases with increase in the growth rate of the crystal. The cylindrical pore shape is the most elementary one; in reality, a broad variety of pore shapes is encountered. Depending on the initial size of the gas bubble, two types of transition processes take place: the pore reaches steady state upon either expanding or contracting. When the crystal-pulling rate is slower than the critical threhold value, variously shaped large pores may form in shaped sapphire crystals owing to the combining of clusters of tiny gas bubbles. Figures 4; references 12: 7 Russian, 5 Western.

[17-1386]

USSR UDC: 548.552.2

DEFECTS IN SAPPHIRE STRIPS SYNTHESIZED BY THE STEPANOV METHOD

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA FIZICHESKAYA in Russian Vol 43 No 9, 1979 pp 1977-1981

PEROV, V. F., PAPKOV, V. S. and IVANOV, I. A.

[Abstract] The Stepanov method for synthesizing sapphire strips serving for theproduction of dielectric substrates of integrated circuits has now become widespread. However, a major impediment to the use of these strips is the marked density of their structural and space defects, particularly a developed block structure and gas inclusions. In this connection, a theory of the formation of both these types of defects is tentatively presented. On the basis of an electronmicroscopic investigation of the formation of bubbles within the sapphire strip as a function of the rate of growth of that strip, it is established that a system of discrete growth stages forms at the edge of the crystallizing front of the sapphire strip. The intercontacting of these stages results in the formation of a cellular structure which contributes to the entrapment of gas pockets (bubbles). Generally speaking, synthetic sapphire is characterized by the formation of a chain of bubbles of a diameter commensurate with the strip thickness, due to the marked dependence of the shape of the crystallization front on the optical transparency of the strip, particularly when the growth rate of the strip is speeded up to > 3.6 mm·min^{-1} and the crystallization process becomes unstable. The principal sources of the bubbles are the gases dissolved in the Al_2O_3 melt. As for block structure, which is the other principal type of defect in sapphire strips, it is found to be due chiefly to the mechanical interaction between the growing strip and the shaping element. A radical means of eliminating block-type defects in sapphire strips is altering the shape of the crystallization front so as to preclude lateral sources of growth stages at both sides of the strip. This can best be accomplished by assuring an acutely convex crystallization front. The resulting sapphire strips contain no bubbles and no block structure. Figures 2; references 9: 7 Russian, 2 Western.

[17-1386]

USSR UDC: 536.42

EXPERIENCE GAINED IN DEVELOPING EQUIPMENT FOR SYNTHESIZING SILICON STRIPS BY THE STEPANOV METHOD

Moscow IZVESTIYA AKADEMII NAUK USSR, SERIYA FIZICHESKAYA in Russian Vol 43 No 9, 1979 pp 1982-1984

FOMIN, G. A., BOL'SHAKOV, YU. V., KOSTEREK, V. K., GOLOVKO, BI. I., GONCHAROV, V. N., ZUYEVA, N. O., YUDINA, N. V., MYTAREVE, N. M., IVANOV, V. I., STREBKOV, D. S., ZADDE, V. V. and SUR'YANINOVA, T. I.

[Abstract] Some results of tests of various experimental models of equipment for growing shaped crystals by the Stepanov method are presented, in particular for a facility designed for the vertical growing of silicon strips in vacuo or in a gas with the aid of graphite heaters. The facility used for growing the strips in vacuo consisted chiefly of two chambers separated by a vacuum-tight shutter--a thermal chamber and a strip-drawing chamber, which made it possible to remove the synthesized strip without cooling the melt. The facility used for growing the strips in argon also contained graphite heaters, as well as a system of molybdenum screens which could be repositioned to adjust the temperature field. Strips reaching 65 mm in width, 800 mm in length, and 0.5-0.8 mm in thickness could thus be synthesized, and the temperature could be stabilized correct to ±(0.25-0.5)°C. Of the strip-shaping elements tested the best results were produced by elements with a concave upper edge. The strips thus synthesized had the p-type of doncutivity, a resistivity of up to 10 ohm·cm, a carrier mobility of up to 200 $cm^2 \cdot sec^{-1}$ and a carrier lifespan of up to 6 µsec. The solar cells fabricated from these silicon strips had a fairly low efficiency, 5-7%, compared with 20% for cells made of single-crystal silicon. However, the efficiency of strip-type solar cells improves with increase in illumination, and this makes it expedient to use them in a combination with optical concentrators, provided that such technical problems as the syntehsis of strips with an extremely smooth surface are solved. Figure 1; references 2, Russian.

[17-1386]

USSR UDC: 548.55

FEATURES OF THE GROWING OF SHAPED SILICON CRYSTALS WITH THE AID OF SHAPING ELEMENTS MADE OF VARIOUS MATERIALS

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA FIZICHESKAYA in Russian Vol 43 No 9, 1979 pp 1985-1988

KRAVETSKY, D. YA., ZATULOVSKIY, L. M., YEGOROV, L. P and KOPYLOV, V. A.

[Abstract] The ideal shaping element in the synthesis of silicon crystals should be inert to the silicon melt and mechanically strong at high temperatures. So far no such material exists, but of the available shaping-element materails the most suitable are graphite, glass-reinforced carbon, quartz, and boron nitride, with the first two being the best. Accordingly the synthesis of shaped silicon crystals with the aid of shaping elements made of graphite and glass-reinforced carbon was experimentally investigated in a vacuum of $1 \cdot 10^{-4}$ torr. The silicon strips thus synthesized had a corss-sectional area of 0.5×18 mm^2 and reached 300 mm in length. It was found that glass-reinforced carbon is not as wettable as graphite with respect to the silicon melt and hence does not shape the crystal strip adequately. Shaping elements made of both materials can be repeatedly reused without fracturing. Both materials are currently the most promising materials for growing thin and broad silicon strips suitable for theproduction of solar batteries. Figure 1; references 18: 13 Russian, 5 Western.

[17-1386]

USSR UDC: 548.55

SYNTHESIS OF SILICON STRIPS FROM THE MELT BY THE STEPANOV METHOD, INVESTIGATION OF THEIR PROPERTIES, AND THE PRODUCTION OF PHOTOVOLTAIC CELLS BASED ON THESE STRIPS

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA FIZICHESKAYA in Russian Vol 43 No 9, 1979 pp 1989-1991

[Abstract] The use of a shaping element made of MPG-6 graphite, capillary feeding via lateral channels, and grooved edges for fixing the width of the silicon strip (SS) has resulted in the synthesis of SS measuring 0.5-0.7 m in length, up to 40 mm in width, and 0.2-0.3 mm in thickness. It was established that SS display a regularly recurrent structure due to the use of rapid growing rates and a graphite shaping element. The principal feature of that structure is the presence of $\{111\}$ plane boundaries that are perpendicular to the strip surface and parallel to the pulling direction. The structure is characterized by twinning defects as well as by surface and inner inclusions of microcrystals of silicon carbide which generate regions of increased stresses. It may be that the characteristic extended dislocation clusters are due to the surface forces exerted by the plane boundaries. All these defects, which reduce the efficiency of photovoltaic cells can in principle be remedied, except the plane boundaries, whose formation is associated with fundamental processes. Photovoltaic cells incorporating silicon strips display cirtually the same spectral sensitivity as their counterparts incorporating single-crystal silicon, except in the $\lambda > 0.6$ μm wavelength range where their sensitivity is worse owing to the short diffusion length of the minority carriers. Such photocells are based on silicon strips that have not been specially doped during their growing. Figures 2; references 6: 1 Russian, 5 Western.

[17-1386]

USSR UDC: 539.2:539.12.04

THE RESONANT SIZE EFFECT IN THE RELAXATION OF SPACE CHARGES IN POLYMETHYL METHACRYLATE

Tomsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY FIZIKA in Russian, No 7(206), 1979, pp 62-67 manuscript received 30 May 78

GUSEL'NIKOV, V. N., YEVDOKIMOV, O. B., KONONOV, B. A., ORLOV, V. L., SOLOV'EV, YU. A. and TUBALOV, N. P., Scientific Research Institute of Electron Internal Flaw Detection, Tomsk Polytechnical Institute imeni S. M. Kirov

[Abstract] An earlier work discovered an effect of space charge transfer created in polymethyl methacrylate by high energy injection. The effect has later been found to be accompanied by elimination of charges of opposite signs created in theprocess of injection. Further experiments reported in this work reveal new and unexpected space-time properties of space charges in PMMS in the relaxation stage. The distribution of charges is found to be radially heterogeneous, in spite of the homogeneity of injection. The time and radius behavior shows singularities at specimen diameters of around 32, 65 and 130 mm, regardless of the method of measurement used. Figures 5; references 7: 6 Russian, 1 Western.

[18-6508]

USSR UDC: 539.2.213

POSITRON STATES ON THE SURFACE AND IN DEFECTIVE SURFACE LAYERS OF SEMICONDUCTORS

Tomsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY FIZIKA in Russian, No 7(206), 1979 pp 71-75, manuscript received 1 Jun 78

AREF'YEV, K. P., PROKOP'YEV, YE. P. and AREF'YEV, V. P., Scientific Research Institute of Nuclear Physics at Tomsk Polytechnical Institute imeni S. M. Kirov

[Abstract] A number of defects which may occur on the surfaces of semiconductors may serve as centers of positron capture. Positron f and $P^0{}_s$states may occur within the volume of the oxide layer on the surface of a semiconductor, particularly if it is powdered. The data presented on surface positron and positronium states indicate that the basic states which can contribute to the long-lived component I_2 are the Tamm positron and positronium states and the ortho $P^0{}_s$ in oxide surface layers. More studies of surface effects in elementary semiconductors are needed. REferences 11: 6 Russian, 5 Western.

[18-6508]

USSR UDC: 539.184.5:548.0

EXCITON SPECTRA OF ANTHRACENE SINGLE CRYSTALS AT THE BOUNDARY WITH A DIELECTRIC AND A CONDUCTING LAYER

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian, Vol 47, No 1, Jul 79, pp 200-202, manuscript received 24 Aug 78

BONDAR, V. V. and KURIK, M. V.

[Abstract] A study is made of the behavior of Frankel excitons in anthracene single crystals located directly on dielectric (fused quartz) and conducting In_2O_3 on glass) substrates. Thin anthracene single crystals grown by sublimation in an inert atmosphere from zone-refined material was used. The reflection spectra were measured in polarized light with near-normal incidence of the light (incidence angle less than 10°). The studies showed that at the interface, deformations play a significant role in the behavior of Frankel excitons, increasing their nonradiative annihilation. Figures 2; references 8; 4 Russian, 4 Western.

[169-6508]

USSR

HELICAL CYCLOTRON WAVES IN METALS WITH OPEN FERMI SURFACE

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKA in Russian Vol 30 No 4, 20 Aug 79 pp 222-226 manuscript received 2 Jul 79

BEZUGLYY, P. A., BURMA, N. G., GRISHIN, A. M., and KABANOV, A. YE., Donetsk Physicotechnical Institute, Physicotechnical Institute of Low Temperatures, Ukrainian Academy of Sciences

[Abstract] In metals with open FErmi surface, the spectrum of electromagnetic perturbations has general distinctive features as compared to metals with closed FErmi surface. Helical cyclotron waves (STsV) at low wave vector $\underline{q}$ are ordinary helicons which are transformed into cyclotron mode as $\underline{q}$ is increased. STsV could be called a wave near diamagnetic resonance. In fact, when $q \parallel Ox$ for a cylindrical Fermi surface $qv = 0$, the wave field for such electrons is uniform and resonance of electrons with the wave only occurs at the fundamental frequency of cyclotron resonance. STsV may occur in resonant interaction with ultrasound. In strong magnetic fields resonant frequency is not similar to ω/H. This effect can not be described within the framework of a cylindrical Fermi surface model and can be explained by the effect of other non-resonant carriers on the STsV spectrum. Figures 2; references 1 Western.

[162-8617]

USSR

THIN-FILM SEMICONDUCTOR POLARITONS

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 30 No 4, 20 Aug 79 pp 244-248 manuscript received 12 Jul 79

KELDYSH, L. V., Physics Institute iemni Lebedev, USSR Academy of Sciences

[Abstract] Earlier studies had shown that in quite thin semiconductor films whose permittivity is much greater than that of the substrate, there is an increase in Coulomb interaction between charges if the distance between them exceeds the thickness of the film. For dipole active excitons, the intensity of the optical transition is determined by the quantity $|\phi(0)|^2$, where $\phi(r)$ is the wave function of relative motion of the electron and hole. $|\phi(0)|^2$ is evidently inversely proportional to the "exciton volume". When there is a decrease in d in addition to an increase in exciton binding energy, its corresponding oscillator strength increases. The contribution of the exciton transition to the electro-magnetic response of the field to a field with a frequency of *omega* and projection of the wave vector to the film plane k can be characterized by applied current density j. If the film is adequately perfect and uniform in thickness, a rapid increase in X_{kw} with a decrease in d should lead to the appearance of clearly expressed poles (maximums) and zeros necessary to display polariton effects. REferences 8: 4 Russian, 4 Western.

[162-8617]

USSR

CONDUCTIVITY OF PLASTICALLY DEFORMED GERMANIUM AT SUPER-LOW TEMPERATURES

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI Vol 30 No 5 Sep 79 pp 303-305 manuscript received 7 Jul 79

ZINOV'YEVA, K. N., KOZHUKH, M. L., TRUNOV, V. A., RYVKIN, S. M. and SHLIMAK, I. S., Institute of Physics and Technology imeni A. A. Ioffe, USSR Academy of Sciences; Institute of Nuclear Physics imeni B. P. Konstantinov, USSR Academy of Sciences

[Abstract] In order to answer the question as to whether the exponential temperature dependences of conductivity of semiconductors as a function of temperature reflect a basically different mechanism of charge transfer, related to the specifics of the "dislocation zone," or whether the exponential area is a transient area, replaced at still lower temperatures by ordinary activation dependences in the super-low temperature region, a

study was made of a series of specimens of plastically deformed germanium with D $\geq$ 30% in the super-low temperature area. No transition to activation conductivity was observed down to temperatures as low as 0.03-0.04 K. Figure 1; references 8 Russian.

[36-6508]

USSR

METALLIC SHIELDING IN A PEIERLS-FRÖHLICH DIELECTRIC WITH PINNING TO IMPURITIES AT FINITE TEMPERATURES

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 26, No 3, May 79 pp 1000-1009 manuscript received 15 May 78

BRAZOVSKIY, S. A., Institute of Theoretical Physics imeni L. D. Landau, Academy of Sciences USSR

[Abstract] An investigation is made of the influence that finite temperatures have on the properties of an isolated one-dimensonal system (filament) with charge density wave in the presence of rare impurities. An examination is made of those cases that have already been considered for the classical model at zero temperature. Although major interest attaches to the functions of dynamic response, chiefly $\varepsilon(k, \omega)$, it has not been possible so far to study them. Instead, the author considers the frequency-integral characteristic $\varepsilon(k)$ calculated within the framework of statistical mechanics. This gives the Debye shielding parameter, and thus enables determination of the effective part of the charge density wave freed from pinning to an impurity as a result of thermal activation. A common temperature-dependent factor is obtained that reduces the quantities $\varepsilon(k)$, Re $\varepsilon(k, \omega)$ and conductivity $\sigma(k, \omega)$. The temperature dependence of the latter two quantities is also determined by the unknown behavior of damping of the phase moade of the charge density wave. The statistical correlation function is found for the phase of the charge density wave, and is used for determining the effective number of free carriers that participate in Frohlic conductivity at a finite temperature. An examination is also made of the correlation function of the order parameter of the system. It is found that a fundamental part is played by the attenuation of the Frohlich mode, which increases with temperature due to interaction with thermal phonons. The author thanks I. Ye. Dzyaloshinskiy for discussions and constructive criticism, and also A. I. Larkin and D. Ye. Khmel'nitskiy for discussing the paper. References 23: 9 Russian, 14 Western.

[98-6610]

USSR

INVESTIGATION OF THE COLLECTIVE PROPERTIES OF A DEGENERATE ELECTRON GAS IN ALUMINUM BY THE (e, 2e) TECHNIQUE

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 26, No 3, Mar 79 pp 1047-1057 manuscript received 20 Jul 78

PERSIANTSEVA, N. M., KRASIL'NIKOVA, N. A. and NEUDACHIN, V. G., Scientific Research Institute of Nuclear Physics, Moscow State University

[Abstract] A theoretical and experimental study is done on the behavior of the differential corss section of the reaction (e, 2e) with knock-on of electrons from metal targets by fast electrons. It is shwon tht the (e, 2e) method enables investigation of both the momentum distributions of the target electrons before interaction, and the collective response of the electron gas to formation of a hole. The spectra of coincidences of final electrons are found on aluminum films about 200 Å thick, with energy resolution $\triangle E$ = 16 eV in the range of scattering angles between 45 and 51°. The measured functions of angle correlations were mostly somewhat wider than the theoretical q dependences of the differential cross section of the reaction (e, 2e) calculated by using Hartree-Fock wave functions for isolated atoms. A state called a plasmaron is distinguished with anomalously narrow momentum distribution. The authors thank V. G. Levin and A. V. Pavlichenkov for valuable advice and assistance with the work, and also S. V. Gubin for assisting with the experiments. Figures 3; references 24: 6 Russian, 18 Western.

[98-6610]

USSR

TWO-DIMENSIONAL ELECTRONIC PHENOMENA IN GERMANIUM BICRYSTALS AT HELIUM TEMPERATURES

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 26, No 3, May 79 pp 1089-1099 manuscript received 30 Aug 78

VUL, B. M. and ZAVARITSKAYA, E. I., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR

[Abstract] The two-dimensional conductivity, Hall effect and Shubnikovde Haas osciallations on the growth surface of germanium bicrystals with angles of slope between 6 and 30° are studied at helium temperatures in magnetic fields of up to $1.2 \cdot 10^7$ A/m^2. A transition from metallic to thermally activated conductivity is observed at an angle of slope of about 8-9°. It

is shown that the minimum metallic conductivity is of the order of $e^2/2\pi h$ in accordance with the simplest theoretical estimates. Shubnikov-de Haas oscillations are observed in the metallic conductivity region at angles of slope of the order of 20° or more. It is shown that these oscillations are due to the contribution of light holes. It is established that as the angle of slope decreases, there is a sharp reduction in donductivity due to a transition to conditions of one-dimensional conductivity. Conduction anisotropy is studied, and a model is proposed to explain the observed effects. The authors thank Yu. A. Bashkirov and V. M. Vinogradov for taking part in the work, and V. G. Veselago for providing the opportunity of making measurements in strong magnetic fields on the Solenoid facility. Figures 9; references 13: 2 Russian, 11 Western.

[98-6610]

USSR

THERMODYNAMICS OF ELECTRONS IN A QUANTIZED SEMIMETAL FILM IN STRONG MAGNETIC FIELDS

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 26, No 3, Mar 79 pp 1136-1150 manuscript received 26 Sep 78

LERNER, I. V. and LOZOVIK, YU. YE., Institute of Spectroscopy, Academy of Sciences USSR

[Abstract] The authors consider dimensionally quantized semimetal films in strong magnetic fields. The kinetic properties of such "quasi-zero-dimensional" objects are described on the basis of a study of the ground state and the thermodynamics of the electron Fermi liquid in the films. The analysis is limited to a two-band model of the semimetal at low temperatures. Even in the ideal gas approximation some of the peculiarities of the system can be qualitatively described: giant jumps in density and magnetic susceptibility, exponential smallness of entropy and heat capacity. The thermodynamic characteristics of the system are calculated with consideration of Coulomb interaction. Transitions to the exciton phase are predicted at certain ratios between the magnetic field and band overlap, and the phase diagram of the system is calculated. An investigation is also made of field-induced rearrangements in equilibrium quasi-two-dimensional semiconductors. The authors thank L. P. Gor'kov for very useful discussions on the applicability of the Feynman diagram method to the quasi-one-dimensional situation. Thanks are also expressed to V. S. Babichenko, S. D[illegible]lavskiy and I. B. Levinson for discussing the issues brought up. Figures [illegible]; references 16: 11 Russian, 5 Western.

[98-6610]

USSR UDC: 517.946.9

APPROXIMATING AN ELECTROMAGNETIC FIELD WITH ANTENNA POTENTIALS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 248, No 2, 1979 pp 328-331 manuscript received 8 May 79

KRAVTSOV, V. V., Moscow State University imeni M. V. Lomonosov

[Abstract] The earlier developed method of Debye antenna potentials for the scalar Helmholtz equation is here extended to the system of Maxwell field equations. The solution $\{E,H\}$ to the homogeneous system of equations

$$\begin{aligned} \text{curl } H &= -ikE \\ \text{curl } E &= ikH \end{aligned}$$

is called an electromagnetic field and is analyzed in the open outer region bounded inside by a closed continuous analytical Lyapunov surface. Two theorems are proved regarding electromagnetic fields continuous at this surface and readiating at infinity. Corollaries to these theorems demonstrate the validity of thus solving boundary-value problems for Maxwell equations in a homogeneous medium. The author thanks A. G. Sveshnikov for the helpful suggestions and for the discussion of the results. The article was presented by Academician A. N. Tikhonov on 18 Apr 79. References 5 Russian.

[46-2415]

USSR UDC: 538.566.5

RIGOROUS CALCULATION OF A PRISM IN MULTIMODE WAVEGUIDE CORNER

Kiev DOPOVIDI AKADEMIYI NAUK UKRAYINS'KOYI RSR. SERIYA A. FIZYKO-MATEMATYCHNI TA TEKHNICHNI NAUKY in Ukrainian No 6, Jun 79 pp 461-465 manuscript received 6 Feb 79

KYRYLENKO, A. O., Institute of Radiophysics and Electronics, Ukrainian Academy of Sciences

[Abstract] Analysis of the properties of functional elements of multimode transmission lines is usually done on the basis of asymptotic methods based on different heuristic assumptions. It was also necessary to obtain data on the basis of a rigorous solution of the corresponding boundary problems. The unknown quantity of results is also linked with the incorrectness of the corresponding operational equations of the first kind. The infinite nature of matrix operators in waveguide problems and the fact that

they are not generally continuous do not permit direct use of algorithms devised by Tikhonov et al. (1974). A method of regularization based on partial inverse of the matrix operator of a system of algrebraic equations of the first kind was developed for the class of problems of waveguide non-uniformity with non coordinate boundaries. The evaluation of Vaganov et al. (1975) gives a good description of the "average line" of the relationship of the coefficient of passage as a function of angle, neglecting, however, resonance situations which lead to the almost total closure of the tract. Additional calculations have shown that these resonance are associated with the existence of good quasi-intrinsic oscillations within the prism. Figures 1; references 6 Russian.

[145-8617]

USSR UDC: 538.3

TRANSITION RADIATION IN A WAVEGUIDE WITH TRANVERSELY INHOMOGENEOUS DIELECTRIC FILLING

Yerevan IZVESTIYA AKADEMII NAUK ARMYANSKOY SSR - FIZIKA in Russian Vol 14 No 1, 1979 pp 3-9 manuscript received 28 Jun 78

BARSUKOV, K. A. and BEGLOYAN, E. A., Yerevan Physics Institute and Leningrad Electrotechnical Institute

[Abstract] The theory of transitional radiation of sources moving perpendicular to the axis of a wave guide with uniform dielectrif filling has been thoroughly studied earlier: transitional radiation intensity is not great. As in axial transit of a source, transitional radiation intensity can be increased by increasing the number of boundaries intersected by the source. A precise solution of such problems has some specific distinctions associated with the structure of orthonormalized intrinsic functions of the cross section of the waveguide. Intrinsic functions of partially filled waveguides are not always orthogonal and generalization of known methods of tackling problems of charge emission in a waveguide with uniform cross section is impossible. These problems are solved without constructing an othronormalized system of intrinsic functions and expressions are derived for the fields and energies of radiation. Given that an infinite filamentary current traverses along the Oy axis at a constant velocity. Because the filament has H_x-, H_y- and E_z-field constituents, TE-waves are excited in the waveguide. The condition of field continuity at the interface of dielectric madia and their disappearance on the waveguide walls yields a system of equations which is used to determine unknown coefficients. Energy losses to radiation per unit length of the filament are calculated. Excitation of TM-waves in a two-layered waveguide is analogous to the above if the filamentary current is replaced by

a charged filament which has H_z-, E_x- and E_y-field constituents. Figures 1; references 3 Russian.

[4-8617]

USSR UDC: 621.396.677.83:519.929.8

SHORT-WAVE ASYMPTOTIC EXPANSION OF AN AXISYMMETRIC ANTENNA FIELD

Yerevan IZVESTIYA AKADEMII NAUK ARMYANSKOY SSR-FIZIKA in Russian Vol 14 No 1, 1979 pp 33-37

IVANYAN, M. I.

[Abstract] The uniform asymptotic expansion of a field was previously derived, using geometric diffraction theory to refine expressions derived in the Kirchhoff approximation for a parabolic antenna irradiated by an electrical dipole. The dipole axis is oriented perpendicular to the parabolic axis. These results are extended to an arbitrary axisymmetric antenna irradiated by a dipole situated at an arbitrary point on its axis. In the geometric optics approximation, the total field of the antenna is written out as the sum of the field geometrically reflected on the antenna surface and the boundary field of the antenna written out in approximation of geometric diffraction theory. The stationary phase method does not take into account the contribution of boundary ponts of the antenna (discontinuous distribution of currents at the edge). The contribution of boundary points should be subtracted to specify the geometrically optical portion from the Kirchhoff approximation. The radiation field of a parabolic axisymmetric antenna with an emitter displaced along the axis can be described similarly. REferences 4: 3 Russian, 1 Western.

[4-8617]

USSR

FOCUSING CONDUCTION ELECTRONS BY A HETEROGENEOUS MAGNETIC FIELD

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 30 No 4, 20 Aug 79 pp 237-240 manuscript received 6 Jul 79

KOLESNICHENKO, YU. A. and PESCHANSKIY, V. G., Physico-technical Institute of Low Temperatures, Ukrainian Academy of Sciences

[Abstract] Focusing electrons in metals by a constant uniform magnetic field is one effective method to study the electron energy spectrum and nature of reflection of charge carriers striking almost normally on the surface of a specimen. The use of a heterogeneous magnetic field for transverse electron focusing (EF) expands the resources for studying charge and conductor boundary interaction. The difference in potentials between the potential contact and a peripheral point on a specimen proportional to the number of non-equilibrium electrons arriving from the emitter to the collector without scattering, as a function of the distance between contacts, will have a singularity where $L = L_0 = R(\phi_0)$, because when L is greater than L_0, electrons escaping from the emitter at angles less than π begin to strike the point of the potential contact. The distribution of electrical potential on the specimen surface is easily derived using an equation of electrical neutrality and Boltzmann's kinetic equations with boundary conditions which take into consideration the nature of reflection of charges by the surfaces of the plate. Because charge displacement depends not only on alpha and beta but also on the dispersion of conduction electrons, the position of the focusing line contains information on the dynamic properties of charge carriers which can be used to monitor the reliability of theoretical models of electron energy spectra. Figures 2; references 3 Russian.

[162-8617]

USSR UDC: 533.6.12

CONCERNING SOLUTIONS OF A DISPERSION EQAUTION FROM THE THEORY OF FREE INTERACTION OF A BOUNDARY LAYER

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 247, No 5, 1979 pp 1085-1088 manuscript received 7 Feb 79

ZHUK, V. I. and RYZHOV, O. S., Computing Center, Academy of Sciences USSR, Moscow

[Abstract] An examination is made of unsteady free interaction of a boundary layer with an external supersonic flow. The analysis is based on a nonlinear theory of perturbations for flows with parameters that do not change in time. A system of asymptotic equations is given that incorporates the time dependence of self-induced pressure. Dimensionless formulas for the components of the velocity vector and pressure are introduced, and the resultant expression is linearized with respect to the amplitude of perturbations. A dispersion relation is given that must be satisfied by the frequency and wave number to ensure existence of a solution of the resultant ordinary differential equation with boundary conditions on a flat plate. It is shown that the solution of this dispersion relation is multiple-valued. A criterion is given for selecting the roots of the dispersion relation in the complex plane for use in finding solutions of the proposed ordinary differential equation. The authors thank Ye. D. Terent'yev for discussion that speeded up completion of this work. Figures 1; references 12: 6 Russian, 6 Western.

[19-6610]

USSR UDC: 532.517

THE INFLUENCE OF MASS FORCES ON THE MOVEMENT OF PARTICLES IN THE LAMINAR SUBLAYER OF A TURBULENT FLOW IN RECTANGULAR CHANNELS WITH VARIOUS SPATIAL ORIENTATIONS

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian, Vol 37, No 2, Aug 79, pp 260-268, manuscript received 2 Oct 78

GRUSHIN, YU. M. and MOSIN, A. A.

[Abstract] A study is made of the problem of the movement of undeformed spherical particles in the laminar sublayer of a developed turbulent flow moving through a straight channel. It is assumed that the basic parameters of the boundary layer are independent of the orientation of the channel and constant over the length of the channel. The equations of motion of the particles in a laminar sublayer were analyzed considering

the effects of the force of gravity. Precipitation on the upper and lower walls of the channel is analyzed, as well as precipitation of solid particles from a gas stream with ascending and descending flow in nonhorizontal channels. References 7: 6 Russian, 1 Western.

[185-6508]

USSR UDC: 533.011.8:621.373.826

CALCULATION OF THE RELAXATION OF A NONEQUILIBRIUM GAS OR PLASMA IN A NOZZLE

Tomsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY FIZIKA in Russian, No 7(206), 1979, pp 99-104 manuscript received 1 Jun 78

NECHESOV, O. P., Leningrad Institute of Mechanics

[Abstract] This work is intended to produce an economical and mathematically consistent method of calculation of the relaxation of a nonequilibrium gas or plasma in a nozzle, and to use it to calculate the vibrational relaxation of a 2-phase mixture in the nozzle of a gas dynamic combustion laser. The method allows rather rapid calculation of complex flows when there is a set of relaxation times in the flow, which differ from each other and depend on the flow parameters. This is achieved primarily by simplification of the algorithm and the use of standard procedures, stepping through regions near equilibrium with large steps between irterations. Figures 2; references 15: 11 Russian, 4 Western.

[18-6508]

USSR

TRANSITION TO TURBULENCE IN COUETTE FLOW

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 30 No 4, 20 Aug 79 pp 226-229 manuscript received 2 Jul 79

KUZNETSOV, YE. A., L'VOV, V. S., PREDTECHENSKIY, A. A., SOBOLVE, V. S. and UTKIN, YE. N. Institute of Automation and Electrometry, Siberian Division, USSR Academy of Sciences

[Abstract] There are two points of view about transition from laminar to turbulent flow: Landau feels it is a sequence of bifurcations which excites new forms of motion of incommensurable frequencies. The other point of view, based on the notion of a stochastic (strange) attractor, states that chaotization of motion is possible with a finite number of interacting modes. This study investigated transition to turbulence in a circular Couette flow: the generation of turbulence combined aspects of both the Landau picture and the notion of a stochastic attractor. As the Reynolds' number increases new modes are excited and there is smooth expansion of prior spectral lines. These conclusions strongly disagree with those of Gollub and Swinney who showed a mump shift to a continuous spectrum. The primary reason for this distinction is that the current experiment used a system with wider clearance between cylinders. At low super-criticality $\epsilon < 0.01$, there is only one peak in the spectrum and the dimensionality of S is two. The model of motion at $\epsilon > 0.08$ is the strange attractor. The dimensionality of the effective phase space S equals five. At high Re, the dimensionality of S increases and the trajectory structure becomes complex. Figures 3; references 4: 2 Russian, 2 Western.

[162-8617]

USSR UDC: 621.375

INFLUENCE THAT THE CONTENT OF REACTING COMPONENTS HAS ON THE MECHANISM OF FORMATION OF INVERSE POPULATION IN A GASDYNAMIC LASER BASED ON A MIXTURE OF CO + N_2) + (N_2 +He)

Novosibirsk FIZIKA GORENIYA I VZRVA in Russian Vol 15, No 3, May/Jun 79 pp 93-101 manuscript received 18 Jul 78

KUDRYAVTSEV, N. N., NOVIKOV, S. S. and SVETLICHNYY, I. B., Moscow

[Abstract] An investigation is made of the mechanism of formation of inverse population in a gasdynamic laser on a mixture of CO + N_2O + (N_2 +He) with varying contents of the reacting components (CO and N_2O). The vibrational temperatures of the asymmetric (T_3) and symmetric (T_2) modes of carbon dioxide were determined, enabling reconstruction of both levels of the lasing transition (001 → 100) in CO_2. The operation of the gasdynamic laser is optimized with respect to the content of the reacting components. Maximum gain is realized in a mixture of $0.05N_2O + 0.05CO + 0.6N_2 + 0.3He$. Figures 9; references 20.

[9-6610]

USSR UDC: 621.375.826

NEW INORGANIC LASER MATERIALS

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA FIZICHESKAYA in Russian Vol 43, No 6, Jun 79 pp 1169-1178

KAMINSKIY, A. A., Institute of Crystallography imeni A. V. Shubnikov, Academy of Sciences USSR

[Abstract] A brief survey of research on the physics of laser crystals doped with trivalent rare earth ions. This research has been concentrated in three main areas: 1. getting stimulated emission on new lasing channels in new and known laser crystals; 2. development of new laser designs and new methods of excitation; 3. investigation of new low-threshold lasing compounds. An examination is made of some new properties of highly concentrated neodymium laser media based on the results of temperature studies of stimulated emission of a new Li-Nd-phosphate glas on two of its lasing channels. It is shown that the undesirable temperature effects of the main lasing channel are not observed in the channel $^4F_{3/2} \rightarrow {}^4I_{13/2}$ with λ = 32 μm. The effective peak orientational cross sections of laser lines are given for low-threshold $KY(WO_4)_2$ and $KGd(WO_4)_2$ crystals doped with Nd^{3+}. Figures 4; references 47: 22 Russian, 25 Western.

[10-6610]

USSR UDC: 621.315.592:621.826

CW HETEROLASERS IN THE InGaAsP SYSTEM

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA FIZICHESKAYA in Russian Vol 43, No 7, Jul 79 pp 1448-1450

ALFEROV, ZH. I., GORELENOK, A. T., KOLYSHKIN, V. I., KOP'YEV, P. S., MDIVANI, V. N., TARASOV, I. S. and TIBILOV, V. K., Physicotechnical Institute imeni A. F. Ioffe, Academy of Sciences USSR

[Abstract] Epitaxial layers of compounds in the InGaAsP system of solid solutions can be grown on an indium phosphide substrate with a completely coinciding lattice parameter and a range of widths of forbidden bands of 0.73-1.35 eV. This covers the window of transparency for optical glass fibers, which makes InP-InGaAsP heterostructures important for emitters and sensors in optoelectronic applications. The authors investigate n-n-p laser structures on n-InP backings oriented in crystallographic plane B(111) or (100). The wide-band n-emitter of the structures was an epitaxial layer of InP or a solid solution of InGaAsP with forbidden band of o.2-1.25 eV doped with tin. The active region had a forbidden band of 0.82-1.25 eV and was either left undoped or was lightly doped with tin. The width of the forbidden band was the same for the p-emitter as for the n-emitter. The acceptor dopant was Mg. Ohmic contacts of Au+Zn and Au+Te were sputtered in vacuum on the p- and n-sides respectively. Continuous lasing was achieved at 300 K on strip heterolasers at a wavelength of 1.3 um. REcord-breaking low-threshold heterolasers were made in the InGaAsP system in the pulse mode at 300 K with threshold current density of 1.2 kA/cm^2. A record-breaking threshold current density was achieved in the cw mode for heterolasers with a wide resonator at 77 K, equal to 50 A/cm^2. Figures 1, references 7: 4 Russian, 3 Western.

[11-6610]

USSR UDC: 535.375.5

OPTIMUM FOCUSING CONDITIONS FOR DIRECT GENERATION OF HIGHER HARMONICS

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA FIZICHESKAYA in Russian Vol 43, No 7, Jul 79 pp 1480-1482

FISHER, R. and VECHOREK, L.-V., Central Institute of Optics and Spectroscopy, Academy of Sciences, East Germany

[Abstract] An investigation is made of the feasibility of improving the efficiency of up-conversion of coherent radiation by focusing the fundamental

radiation of a laser in a nonlinear medium. Focusing is accompanied by two competing effects: increasing intensity of the fundamental emission and disruption of conditions of spatial synchronism. Therefore the problem of optimizing focusing involves determination of the optimum phase detuning with respect to the direction of average propagation of interacting waves for a given focusing parameter that maximizes the intensity of the harmonic. These optimum conditions are determined for generation of even and odd harmonics up to the seventh. The inclusion of even harmonics covers generation in media without centers of inversion, i.e. in crystals. It is found that strong focusing is advantageous for higher harmonics under optimum focusing conditions. The power of the m-th harmonic is proportional to ξ^{m-3} ($\xi = L/b_1$ is the focusing parameter, L is the length of the nonlinear medium, b_1 is the confocality parameter of the fundamental wave). Figures 3; references 6 Western.

[11-6610]

USSR UDC: 621.378.325

A COHERENT RADIATION GENERATOR PRODUCING SUBNANOSECOND PULSES TUNABLE IN THE MIDDLE AND FAR IR BAND

Moscow IZVESTIYA AKADEMII NAUK SSSR SERIYA FIZICHESKAYA in Russian, Vol 43 No 8, 1979, pp 1762-1765

BABIN, A. A., BELYAYEV, YU. N., VEREVKIN, YU. K., FREYDMAN, G. I. and SHCHELOKOV, A. N., Institute of Applied Physics, USSR Academy of Sciences

[Abstract] The effect of induced Raman scattering in compressed gases has been used to create compressed hydrogen generators, pumped either by a tunable Nd glass laser or by a tunable dye laser. However, several stages of Raman scattering are necessary to produce light in the middle and far IR band. This system can be significantly simplified if the radiation of a parametric light generator, tunable over the near IR band, is used to pump the device. A diagram is presented of an installation which uses this device, and achieves sufficient radiation intensity in the required frequency range to make the process practical. The theoretical variation of minimum pumping energy necessary to excite the Raman scattering generator as a function of wave length is presented. Figures 3; references 7: 5 Russian, 2 Western.

[21-6508]

USSR UDC: 621.373.826.038.824

A DYE-SOLUTION LASER WITH DISTRIBUTED FEEDBACK, INDUCED BY THE PUMPING

Moscow IZVESTIYA AKADEMII NAUK SSSR SERIYA FIZICHESKAYA in Russian, Vol 43, No 8, 1979, pp 1773-1777

RUBINOV, A. N., EFENDIYEV, T. SH., BOR, ZH., KOZMA, L. and RATS, B., Institute of Physics, BSSR Academy of Sciences

[Abstract] This article reports on the avhievement of lasing in the 438-640 nm spectral range using a laser with distributed feedback based on dyes excited by a nitrogen laser, and analyzes the characteristics of the device. Oscillograms of the pulses of the laser, with and without an external mirror, are presented. The additional mirror more than doubles the intensity of lasing and decreases beam spread from 10 to 2.5 mrad. The studies show that molecular nitrogen lasers can be successfully used to excite lasing in dye solutions by the principle of distributed feedback. This allows the creation of extremely simple laser systems, operating stably at pulse repetition frequencies of 50-100 Hz, with a spectral line about 1 Å wide and smooth tuning of wave length over the entire visible area of the spectrum. Figures 2; references 13: 8 Russian, 5 Western.

[21-6508]

USSR UDC: 621.378.335

INTENSITY FLUCTUATIONS OF RADIATION FROM A SINGLE-FREQUENCY YAG-LASER

Gorkiy IZV. VUZ: RADIOFIZIKA in Russian Vol 22, No 7, Jul 79 pp 813-818 manuscript received 30 Jun 78

[Abstract] An experimental study was made of radiation intensity fluctuations in a YAG:Nd^{3+} laser pumped with a steady krypton discharge and operating in the single-frequency continuous mode. The resonator cavity was formed with four plane mirrors, a Fabry-Perot etalon placed inside. The modal content of the laser radiation was measured with an interferometer and recorded on an oscillograph, the spectral content of the radiation was measured with an analyzer. The instrumentation included also a photoreceiver, a wideband amplifier and a piezoceramic voltage regulator. The fluctuations of radiation intensity, determined from these measurements and further evaluated on the basis of theoretical energy relations, are now shown to yield certain dynamic characteristics of such a solid-state laser such as the longitudinal relaxation time, the population difference, and the resonator bandwidth. It is thus ultimately possible to experimentally determine the width of the luminescence line. The author

thanks A. M. Mak and N. M. Glaktinova for their interest in this study and their assistance in setting up the experiment, also I. L. Bershteyn and YA. I. Khanin for their helpful comments. Figures 4; references 12: 8 Russian, 4 Western.

[50-2415]

USSR UDC: 538.574.8

FLUCTUATIONS OF RADIATION INTENSITIES AT TWO WAVELENGTHS IN A TURBULENT MEDIUM

Gorkiy IZV. VUZ: RADIOFIZIKA in Russian Vol 22, No 7, Jul 79 pp 843-847 manuscript received 7 Aug 78

GURVICH, A. S. and KAN, V., Institute of Atmospheric Physics, USSR Academy of Sciences

[Abstract] An experiment was performed to establish the frequency correlation between intensity fluctuations of radiation at two different wavelengths, from two sources, propagating through a randomly nonhomogeneous medium. Beams from a helium-neo laser (λ= 0.63 μm) and a helium-cadmium laser (λ= 0.44 μm) were collimated, superposed, and transmitted horizontally through a convectively turbulent layer of water between two parallel heat exchanger surfaces. Here the results of fluctuation measurements are compared with the results of calculations in the smooth-perturbation approximation. The correlation coefficient is found to decrease with increasing values of the logarithmic longitudinal wave propagation parameter. Measurements, therefore, yield an estimate of the frequency correlation when the intensity fluctuations are strong. The smooth-perturbation approximation yields overestimates, while assuming a "normal" field distribution yields appreciable underestimates. The authors thank V. I. Shishov for his interest in this study and V. U. Zavorotnyy for the helpful discussion. Figures 2; references: 15 Russian.

[50-2415]

USSR UDC: 539.184.5+621.373:535

PROCESSES OF EXCITATION OF ATOMS UPON ABSORPTION OF LASER RADIATION BY ALKALI METAL MOLECULES

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian. Vol 46, No 6, Jun 79, pp 1112-1120, manuscript received 23 Nov 78

KRAULINYA, E. K. and YANSON, M. L.

[Abstract] A study is made of alkali metal vapors consisting of a mixture of atoms and a small quantity of dimers, excited by an He-Ne, Ar^+ or He-Cd laser at 200-600°C, excitation power $\leq$100 mW. Several mechanisms are involved in excitation of the atoms, including photodissociation and predissociation, nonresontant excitation, and transfer of the electron energy by collisions by molecules and atoms. The partial contribution of each of these mechanisms depends on the concentration of atoms in the base state, the intensity and frequency of excitation. The effectiveness of excitation of continuous molecular bands of potassium was found to ber very high, indicating the possibility of creation of inversions over a rather large area of the spectrum. Figures 4; references 23: 14 Russian, 9 Western.

[170-6508]

USSR UDC: 621.373:535.01

THE THEORY OF FREQUENCY INDEPENDENCE OF OPPOSITELY DIRECTED WAVES IN A GAS RING LASER WITH IRISED SPHERICAL MIRROR AND SPATIAL NONUNIFORMITY OF THE MEDIUM

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian, Vol 46, No 6, Jun 79, pp 1210-1212, manuscript received 23 Nov 78

BOYTSOV, V. F.

[Abstract] Results are presented from calculation of the diffraction frequency difference for a model of a laser with a gaussian diaphragm and a "square" amplifying medium. A ring laser is studied, with two flat mirrors and one spherical mirror. In the region of high splitting frequencies a decrease in effective transverse dimensions of the active medium and a decrease in mirror transmission losses lead to a decrease in $\delta\omega$; when the tube is placed at the symmetrical point of the resonator, $\delta\omega$ decreases rapidly, leading to instability of the difference frequency of the laser. When the tube is placed near the spherical mirror of the resonator, a similar, though less clearly expressed, instability occurs. Figures 3; references 10: 8 Russian, 2 Western.

[170-6508]

USSR

A $CO_2/^{192}OsO_4$ LASER: ABSOLUTE FREQUENCY OF LIGHT OSCILLATIONS AND NEW CAPABILITIES

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI Vol 30 No 5 Sep 79 pp 269-272 manuscript received 12 Jul 79

DOMNIN, YU. S., KOSHELYAYEVSKIY, N. B., TATARENKOV, V. M., SHUMYATSKIY, P. S., KOMPANETS, O. N., KUKUDZHANOV, A. R., LETOKHOV, V. S. and MIKHAYLOV, YE. L., All-Union Scientific Research Institute for Physical-Technical Electronic Measurements; Institute of Spectroscopy, USSR Academy of Sciences

[Abstract] A report is presented of the first absolute measurement of the frequency of a $CO_2/^{192}OsO_4$ laser, obtained by stabilization of the frequency of a CO_2 laser on the P(14) line with a narrow nonlinear resonance in the vibrational-rotational spectrum of the $^{192}OsO_4$ molecule. The $CO_2/^{192}OsO_4$ laser is the first optical standard, the frequency of which has been measured to an accuracy of $3 \cdot 10^{-11}$. This measurement accuracy opens the possibility of performing experiments to test the hypothesis of constance of universal constants. References 11: 8 Russian, 3 Western.

[36-6508]

USSR

ABSOLUTE MEASUREMENTS OF THE FREQUENCIES OF IR-BAND LASERS

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI Vol 30 No 5 Sep 79 pp 273-275 manuscript received 12 Jul 79

DOMNIN, YU. S., KOSHELYAYEVSKIY, N. B., TATARENKOV, V. M. and SHUMYATSKIY, P. S., Institute of Spectroscopy, USSR Academy of Sciences

[Abstract] A report is presented on a significant increase in the accuracy of precision frequency measurement of the CO_2/OsO_4 and He-Ne/CH_4 optical standards. The achievement is based on an efficient structure of the system of measurements selected. The introduction of D_2O and CO_2/OsO_4 lasers has resulted in the achievement of a satisfactory signal-to-noise ratio throughout the entire system (at least 20 DB in the 50 kHz band). The CO_2/OsO_4 laser frequency is measured with an error of ± 1 kHz, that of the He-Ne/CH_4 laser--with an error of ± 10 kHz. It seems quite realistic to expect the creation of a CO_2/OsO_4 laser with a long-term frequency stability of 10^{-13}. References 6: 3 Russian, 3 Western.

[36-6508]

USSR UDC: 532.32

OPTICAL HOMOGENEITY OF THE MEDIUM IN A PULSED PHOTOIONIZATION CO$_2$ LASER AT ATMOSPHERIC PRESSURE

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 49 No 7, Jul 79
pp 1567-1570 manuscript received 9 Nov 78

ZNAMENSKIY, V. B., REZUNKOV, YU. A., SINOPAL'NIKOV, A. K. and STEPANOV, V. V.

[Abstract] It has generally been assumed that gasdynamic redistribution of gas density owing to shock waves in photoionization and electron-ionization lasers lasts tens of microseconds; the results presented here indicate that the main inhomogeneity is in the earliest stages. Shear interferograms of the authors' laser apparatus show development of optical inhomogeneity in three perturbation zones with three different types of inhomogeneity: the near-anode zone, with the largest perturbations; the middle zone, in which the disturbance was pronounced for about 1.2 microseconds and decreased with distance from the cathode; and the cathode zone, where spatially limited streamers were observed. The inhomogeneity was found to be independent of photoelectron concentration from 10^9 to 10^{10} cm^{-3}. The possibility of improving laser characteristics by positioning the resonator axis so as to avoid the most intense inhomogeneities, particularly in the near-znode zone, is examined. Similar effects are observable in electroionization lasers. The authors thank A. Anan'yev and O. A. Shorokhov for support and L. D. Smirnov for measurements and calculations. Figures 2; references 6: 3 Russian, 3 Western.

USSR UDC: 621.378.325

CHARACTERISTICS OF THE RADIATION OF CO$_2$ LASERS AT A HIGH PUMPING LEVEL

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 49, No 7, Jul 79
pp 1572-1574 manuscript received 2 Oct 78

BYCHKOV, YU.I., KUDRYASHOV, V. P., KURBATOV, YU. A., ORLOVSKIY, V. M., OSIPOV, V. V. and SAVIN, V. V., Institute of High Current Electronics, Siberian Department, USSR Academy of Sciences, Tomsk

[Abstract] Powerful short pulses (~10^{-8} - 10^{-9} sec) have been obtained in free lasing, but their spectral composition has not been studied. Here a theoretical and experimental study of the production of powerful short pulses with simultaneous lasing from many vibrational-rotational transitions is presented. A new theoretical model takes account of energy exchange between VR sublevels in the 001, 020 and 100 states, making it possible to find the spectral characteristics. Calculations indicate that

spectral content depends on pressure: at 7 atm and 0.4 J/cm^3-atm, 65% of the energy is at P_{22} and the rest between P_{18} and P_{26}; at 9 atm, the maximum (70%) is at P_{28} and the rest distributed between P_{18} and P_{30}; the nonuniform distribution of energy results from faster rotational relaxation and faster VT relaxation. When the gain rises above the threshold value, the pulse length decreases as energy input increases; further increases, however, increase pulse length as a result of energy transfer to an upper laser level. For a fixed energy input of 0.4 J/cm^3-atm, the pulse length decreases as pressure increases. For a fixed resonator length there is an optimal coupling coefficient resulting in a minimal pulse length, and there is an optimal resonator length for fixed R. Preliminary experiments with a 100 cm cavity, a pressure of 1.5 atm and a 1:1 mixture of CO_2 and N_2 gave the following results: with $R < 1\%$, a pressure of 4 atm, and $W_e = 0.25$ J/cm^3-atm, a pulse half-width of 15 ns a specific radiative energy of 0.014 J/cm^3 and an efficiency η^* of 2% were obtained. The spectrum included 17 P-branch lines in the vicinity of P_{18}, and three R-branch lines: R_{22}, R_{24} and R_{26}. An increase of R to 9% led to a pulse length of 25 ns and an increase of η^* to about 6%. Thus short pulses can be generated if the threshold value g_0 is so great that after cessation of the vibrational transition as a result of emission of the initial power peak, the next pumping of the 001 level does not bring the gain above the level of losses in the resonator. The authors thank S. I. Petukhova for aid in calculations. Figures 2; references 3: 2 Russian, 1 Western.

USSR UDC: 621.378.8:535.35

ENERGY CHARACTERISTICS OF ArI, KrI, AND XeI TEA LASERS

Leningrad ZHURNAL TEKHNICHESKOY FIXIKI in Russian Vol 49 No 8, Aug 79
pp 1673-1677 manuscript received 7 Apr 78; after editing, 18 Jan 79

SOROKIN, A. R., Novosibirsk, Institute of Heat Physics, Siberian Affiliate of the USSR Academy of Sciences

[Abstract] Considering that atomic-line high-pressure lasers can serve as sources of tunable-frequency radiation, the optimal conditions for the excitation of He-Xe, He-Ar, and He-Kr lasers were investigated in a specially designed experimental setup. The similar structure of atomic levels of the heavy inert gases as well as, apparently, identical processes participating in population inversion, require roughly identical conditions of excitation--and indeed it was found that the optimal conditions of excitations known for He-Xe lasers were approximately the same as for He-Ar and He-Kr lasers: in all cases lasing time did not exceed 100 nanoseconds. The laser effect in inert-gas lasers is observable in

the form of two time-distributed components of which the first, fast component, coincides with the excitation pulse and the second, slow component corresponds to the afterglow of the discharge. In this connection it was found that for all the three laser types investigated theprincipal part of radiation is contained in the fast component, in certain conditions. The efficiency of the He-Xe laser investigated, 0.3%, is apparently close to the possible maximum for excitation by means of a transverse discharge with prior ionization of the cell; for the He-Kr laser this efficiency is 0.1% and for the He-Ar laser it is 0.2%. The experiments revealed the existence of a new lasing line, λ = 5.13 μm, which may be associated with the transition $7X-3s_1'$ or $7Y-3s_1'$ for atomic Xe. Figures 4; references 12: 5 Russian, 7 Western.

[32-1386]

USSR UDC: 621.378.325

AMPLIFICATION OF A GAS-DYNAMIC CO_2 LASER IN THE PRESENCE OF PARTIAL INVERSION AT THE 16 μm WAVELENGTH

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 49 No 9 Sep 79 1918-1923 manuscript received 18 Jan 79

KONEV, YU. B., Moscow, Institute of High Temperatures, USSR Academy of Sciences

[Abstract] The amplification factor of the gas-dynamic CO_2 laser at 16 μm wavelength in the presence of partial inversion at the $(10^\circ0, 02^\circ0)_{II}-(01^10)$ transition of CO_2 molecules is investigated in relation to stagnation temperature and pressure, height of the critical cross section, degree of nozzle expansion, and relative content of CO_2 in a binary mixture with argon. The greater the degree of expansion, the lower the gas temperature becomes and correspondingly the higher the amplification becomes. With increase in stagnation temperature, amplification decreases. The greater the ratio of CO_2 to argon, the higher the energy margin, but then also the degree of expansion increases markedly. The optimal concentration of water present should be $\lesssim$ 0.1%. Figures 5; references 18: 9 Russian, 9 Western.

[33-1386]

USSR

RECOIL MOMENTUM OF TARGETS EXPOSED TO LASER RADIATION

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 49 No 9 Sep 79 pp 1924-1927 manuscript received 16 Oct 78

ASHMARIN, I. I., BYKOVSKIY, YU. A., KOZIN, G. I., KOSTROMIN, A. B. and CHISTYAKOV, A. A., Moscow Engineering Physics Institute

[Abstract] The recoil momentum imparted to a target exposed to a giant ruby laser pulse was investigated. The measurements were performed with the aid of a piezopickup. The recoil momentum was determined as a function of laser radiation ranging from $3 \cdot 10^7$ to $3 \cdot 10^9$ watt/cm^2 and of ambient pressures ranging from 10^{-4} mm Hg to 1 atm. The target material in all experiments was lead. It was found that the recoil momentum increased with increase in pressure. A consideration of the processes causing the recoil momentum of the target indicates that they are principally due to the thermal pressure exerted by the plasma on the target surface and less significantly to the spread of the matter that had been initially compressed in the process of heating by the laser pulse. The conducted estimates show that the chief influencing factor is the relaxation time of the thermal pressure of plasma at the target. Figures 4; references 14: 11 Russian, 3 Western.

[33-1386]

USSR UDC: 535.35

INCOHERENT INTERACTION OF A LIGHT PULSE WITH SEMICONDUCTIVE AND MOLECULAR MEDIA WITH CONSIDERATION OF INTRABAND RELAXATION

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA FIZICHESKAYA in Russian Vol 43, No 7, Jul 79 pp 1517-1522

IL'INOVA, T. M., BOGDANOVA, M. V. and FORTYGIN, A. A., Moscow State University imeni M. V. Lomonosova

[Abstract] The energy model of a molecule that accounts for the vibrational structure of electron states is similar in form to the band model of a semiconductor. The use of such models to describe the interaction of a light pulse with a medium enables consideration of processes of vibrational relaxation in a molecular medium, and intraband relaxation in a semidonductor. Based on the diffusion approximation, the authors develop a general approach to problems of resonant interaction of pulse emission with molecular and semiconductor media. The following principles are found for nonlinear amplification of a pulse in a relaxing medium: 1. intraband relaxation delays the process of peaking of the square input pulse; 2. depending on its value at the input, the energy of a pulse either monotonically decreases or increases, or else passes through a maximum at a certain distance from the input; 3. the extremum behavior of energy dictates the optimum amplification length. Figures 2; references 4: 2 Russian, 2 Western.

[11-6610]

USSR

DETECTION OF A SHARPLY RESONANT STRUCTURE OF ABSORPTION OF ENERGY BY MOLECULES OF SULFUR HEXAFLUORIDE IN A STRONG IR LASER FIELD

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI Vol 30 No 5 Seo 79 pp 279-282 manuscript received 19 Jul 79

ALIMPIYEV, S. S., KARLOV, N. V., MESYATS, G. A., NIKIFOROV, S. M., ORLOVSKIY, V. M., PROKHOROV, A. M., SARTAKOV, B. G., KHOKHLOV, E. M. and SHTARKOV, A. L.

[Abstract] A report is presented on the discovery of sharp peaks of resonant absorption of laser radiation energy by SF_6 molecules, performed using a high-pressure CO_2 laser. The absorption of energy in the gas was measured by an optico-acoustical method. The structure which is discovered is apparently common for molecules of this class and can be used to increase the selectivity of excitation of heavier molecules. Figures 2; references 7: 4 Russian, 3 Western.

[36-6508]

USSR UDC: 533.933

SIMULTANEOUS CALCULATION OF VIBRATION KINETICS AND PLASMA CHARACTERISTICS OF A SPACE DISCHARGE IN A MIXTURE OF CO AND N_2

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 49 No 7, Jul 79
pp 1412-1417 manuscript received 30 Nov 78

BELOUSOVA, I. M., LEONOV, S. N., LUKONEN, R. A. and PIVOVAR, V. A.

[Abstract] Powerful pulse discharges in molecular gases are of interest because of the large proportion of electrical energy which goes into vibration levels, particularly in CO. Theoretical discussion of the process is complicated by the lack of suitable models for nonstationary conditions; this is because the working transitions involve high-lying ($v > 6$) levels. Here a joint calculation of the nonstationary vibrational kinetics and the electron energy distribution function is made for a space discharge in a $CO-N_2$ mixture. The kinetic equation for the change of population of a level contains four terms accounting for: interaction with electrons, vibrational-vibrational exchange, vibrational-translational exchange and spontaneous emission. The temperature-dependent VV and VT constants are derived from the Herzfeld formula for transition probabilities modified for nonadiabatic transitions and the presence of long-range components in the intermolecular potential. The electron excitation constants depend on the electron distribution function and excitation cross sections; the electron distribution function can be obtained by solving the kinetic Boltzmann equation. The time required to establish a stationary discharge with an external ionization source is much shorter than the time for change of population, so the electron distribution function is assumed to follow population levels in a wuasistationary manner. In the joint solution of the Boltzmann equation and the population equations the following inelastic processes are considered: excitation of 8 electron levels, direct and stepwise excitation of the first 8 vibrational levels, and type 2 [soft] collisions. The electric field intensity is assumed constant. The conditions are: $CO/N_2 = 1:5$, 200 K, molecular concentration $1.34 \cdot 10^{19}$ cm^{-3}, electron concentration $2 \cdot 10^{13}$ cm^{-3}, $E/N = 3 \cdot 10^{-16}$ $V\text{-}cm^2$. Graphs of the results are presented. Initially the population of the first 8 levels rises, producing a highly non-Boltzmann distribution; next VV redistribution produces a plateau at levels 7-16. The electron energy distribution function is non-Maxwellian. The high-energy (over 3 eV) end gradually increases by about 5%. When there is a large population of vibrational levels with $v > 1$, the decrease in power loss through excitation of the first 8 vibrational levels from the ground state is compensated by a growing role for stepwise excitation (especially in N_2). The energy involved in soft collisions also increases. After 10-12 microseconds, 25% of power loss is in stepwise excitation and 10% in type 2 collisions. Thus the average electron energy increases and the shape of the energy distribution function changes. The increase in the high end of the electron distribution function results in increased electron-level excitation and ionization, which makes instabilities possible. An important use of the calculation presented is in dealing with the problem of discharge instability. Figures 3; references 21: 8 Russian, 13 Western.

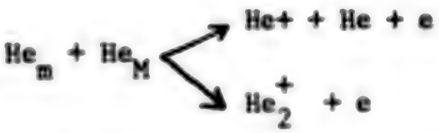
USSR UDC: 537.521

A MASS-SPECTROSCOPIC INVESTIGATION OF THE PROCESS OF FORMATION OF THE HELIUM MOLECULAR ION He_2^+ DURING DECAY OF A PULSED PLASMA DISCHARGE

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 49 No 7, Jul 79
pp 1418-1424 manuscript received 1 Apr 76, final revision 22 Jun 78

BORISOV, V. B., YEGOROV, V. S., ZATSERKOVNYUK, N. M., PASTOR, A. A. and FARES, E., Leningrad State University imeni A. A. Zhdanov

[Abstract] Molecular ions in inert gases affect charged-particle processes and are also relevant to laser action. Here an analysis is provided of results given in a previous article. Recording of ion current in a plasma discharge in helium (pulse length, few microseconds; current density, 1-12 A/cm^2, pressure 1-10 Torr) using a quadrupole mass spectrometer showed two maxima for He_2^+: one during the discharge and one during its decay. An increase in the pulse current produced an increase in the first maximum and a decrease in the second. Molecular ions always represented a considerable proportion (about 20%) of the charged particles. Of primary interest is the formation of atomic and molecular ions after the discharge (with a weak pulse, energy is mostly stored in metastable atoms which collide after the discharge). It was previously thought that molecular ions are produced by triple collisions and atomic ions by double collisions, but the current data indicate that both result from pair collisions, since at 3 Torr He_2^+ predominates over He^+; the amount of He_2^+ should be about 1/10 that of He^+ if triple collisions are involved. Thus the reaction is:



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An analytical solution of thekinetic equations involved using certain simplifying assumptions indicates that the ratio of the integral concentrations of molecular and atomic ions should be equal to the ratio of their formation rates divided by the ratio of their destruction probabilities. This equation is assumed to hold even when an analytic solution is not possible. In the mass spectrometer, the ratio of the time integrals of current densities is shown to be equal to the ratio of rates of formation of the two ion types. Reaction of particles with the apparatus is not a factor if certain procedures are followed. The multiplier for differential sensitivity of the secondary electron multiplier circuit to the particles is found to be equal to 1.8 and the measured ratio of integral currents to be 4, so that the ratio of formation rates is about 2.2; thus He_2^+ is 2.2 times as likely to be formed in the collision described. The main error source is dissociative recombination, which might lower the ratio by as much as half. Figures 2; references 14: 5 Russian, 9 Western.

USSR UDC: 533.933

A NUMERICAL INVESTIGATION OF RELAXATION OF THE ELECTRON DISTRIBUTION FUNCTION IN DISCHARGE PLASMA IN MIZTURES OF CO_2, N_2 and He

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 49 No 7, Jul 79
pp 1425-1435 manuscript received 18 Jul 78

PIVOVAR, V. A. and SIDOROVA, T. D.

[Abstract] Investigation of the relaxation of the electron distribution function in a discharge plasma is especially relevant to atmospheric-pressure, short pulse, high-power CO_2-N_2 lasers. A numerical solution of the nonstationary Boltzmann equation is developed, assuming the electron concentration to be externally controlled and fixed, the degree of ionization equal to $10^{-7} - 10^{-6}$, application of an instantaneous field, and a value $E/N - 10^{-16} - 10^{-5}$ V-cm. Electron-electron and electron-ion collisions are neglected. The nonstationary Boltzmann equation has three terms representing the increase in electron energy due to the electric field, the rate of elastic collision losses and the rate of inelastic losses (for which the cross sections are known). The following phenomena are taken into account: for N_2, rotational excitation, vibrational excitation from ground state (first 8 levels), five electron excitation states and ionization; for CO_2, 3 vibrational levels (deformation, symmetrical and asymmetrical stretching), excitation of 2 electron states, dissociative sticking and ionization; for He, 3 electron levels and ionization. Soft collisions are neglected. A new implicit different method is used, providing more accurate results. Three series of calculations were made: relaxation of the electron energy distribution function and average energy for CO_2 and for N_2 (for various values of E/N), and relaxation for a mixture with He. Graphs of the relaxation of the electron distribution function and the average energy are presented. The behavior of both is explainable in terms of the time dependency of the collision frequency. This is high initially owing to the large vibrational excitation cross sections between 0.083 and 0.05 eV, and accordingly the average energy rises slowly and the electron energy distribution function drops off rapidly; between 0.05 and 0.15 eV, there are no processes with large cross sections, so that average rises rapidly and there is a section of shallower descent in the electron energy distribution functions in this energy range. Other areas of large excitation cross sections are between 2 and 4 eV and above 7 eV; these areas too result in more rapid drops in the electron energy distribution function as a result of increased collision frequencies. A similar analysis applies to the case of N_2. The behavior of the collision energy loss frequency in N_2 was examined at two different temperatures, 100 and 300 K. At 100 K there were more rotational losses, fewer levels populated and more hard collisions; at 300 K there were more levels populated and some type 2 [soft] collisions, with smaller rotational losses. For N_2, accordingly, the main collisional barrier is rotational. Electron level excitations are relevant only for large values of E/N. Co_2 has a larger frequency of inelastic collisions and thus the

relaxation time for average energy is longer in N_2. For a mixture of CO_2, N_2 and He the situation was not much more complex. Between 0 and 20 eV the composition of the mixture was the deciding factor since it governed the distribution and importance of the various cross sections. The relaxation time of average energy and electron energy distribution in a mixture of the three gases in the proportion 1:4:5 at atmospheric pressure ranged from $1 \cdot 10^{-10}$ to $3 \cdot 10^{-10}$ with E/N between $10 \cdot 10^{-6}$ and $1 \cdot 10^{-16}$ V-cm^2; this was between the values for pure nitrogen and pure CO_2. Figures 8; references 23: 6 Russian, 17 Western.

USSR UDC: 533.7.537.521

THE EFFECT OF STEPWISE EXCITATION OF N_2 VIBRATIONAL LEVELS ON THE ELECTRON ENERGY BALANCE IN A SPACE DISCHARGE

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 49 No 7, Jul 79 pp 1436-1440 manuscript received 8 Aug 78

PIVOVAR, V. A. and SIDOROVA, T. D.

[Abstract] Most calculations of the electron energy distribution ignore stepwise excitation, but when the energy input Q/P is equal to or greater than 1, stepwise excitation becomes important for the first 8 levels. The stepwise excitation constants are generally bigger than the direct excitation coefficient for j 8. A numerical solution of the kinetic Boltzmann equation is obtained for the electron energy distribution function for a CO_2-N_2-He mixture and the contribution of stepwise excitation of the first 8 vibrational levels to the energy balance (foe E/N=0.1 - 10 x 10^{-16} V-cm^2) is studied. Soft collisions are considered. The equation has four terms, representing: energy increase due to the electric field, elastic collisions, inelastic collisions and type 2 [soft] collisions. The following factors are considered: for CO_2 the first 3 vibrational modes, 2 electron states, dissociative sticking and ionization; for N_2, excitation of the first 8 vibrational levels from all lower levels, 5 electron states and ionization; for He, 3 electron states and ionization. The percentage of energy going to vibrational excitation in N_2 and the proportion of energy going to stepwise excitation of the first 8 vibrational levels are calcualted as a function of the vibrational temperature. For pure nitrogen, most of the energy goes to vibrational excitation in the middle range (between areas of predominant elastic scattering and electron excitation). Addition of CO_2 decreases the figure because of inelastic losses in vibrational excitation of CO_2. When E/N $\gtrsim 3 \cdot 10^{-16}$ V-cm^2, type 2 collisions become important. The percentage of energy going to stepwise excitation of vibrational levels in N_2 is a maximum of 0.45 at 2000 K; in a mixture with CO_2 and He falls to 0.18-0.15. At 1000 K the maximum is 0.18, dropping to 0.04-0.05 on addition of CO_2 and He. The results indicate that stepwise excitation must be taken into account for a high legel of vibrational excitation in a plasma discharge in the mixture considered. Figures 1; references 16: 8 Russian, 8 Western.

USSR UDC: 539.12

SELF-FOCUSING OF ELEMENTARY PARTICLE WAVE PACKETS

Minsk DOKLADY AKADEMII NAUK BSSR in Russian Vol 23, No 4, 1979 pp 326-329 manuscript received 2 Aug 78

BARYSHEVSKIY, V. G. and FERANCHUK, I. D., Belorussian University imeni Lenin

[Abstract] Numerical analysis has shown that in silicon, at positron energy above 10 GeV, radiative cooling of the transverse momentum of channelized particles $p_\perp$ prevails over the increase in $p_\perp$ due to repeated scattering and leads to a net decrease in $p_\perp$ in a crystal 0.5 centimeters long. Radiative cooling which reduces $p_\perp$ slightly alters the amplitude of osciallations, even of the positrons. Reduction of transverse dimensions of a particle packet permits an increase in the probability of collisions in counter beams moving in a single crystal. Another method of beam focusing is as follows: interaction of ultrarelativistic charged particles with phonons leads to the appearance of nonlinear contributions to the index of refraction of the particle and consequently, to the formation of nonlinear effects in the motion of a wave packet in the medium (self-focusing and self-compression). Particle spin must be considered: a particle moving in a medium induces intrinsic magnetic fields which can cause significant rotation of spin. As particle energy grows, the contribution to the effect of spin rotation and the nature of its motion in yndulators begins to produce radiation friction. References 8: 7 Russian, 1 Western.

[2-8617]

USSR

SEARCH FOR THE ISOTOPE He^{10} IN REACTIONS OF FRAGMENTATION OF Th^{232} TARGET NUCLEI

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI Vol 30 No 6 20 Sep 79 pp 349-354 manuscript received 16 Jun 79

BEZNOGIKH, G. G., ZHIDKOV, N. K., KIRILLOVA, L. F., NIKITIN, V. A., NOMOKONOV, P. V., ABDEYCHIKOV, V. V., MURIN, YU. A., OPLAVIN, V. [illegible]., MAYSYUKOV, V. D., MASLENNIKOV, YU. V., SHEVCHENKO, A. P., BUYAK, A. and SHABLOVSKIY, M.

[Abstract] An experiment mentioned in the title was performed on the synchrophasotron of the Joint Institute of Nuclear Research. A flux of deuterons at 4.8 GeV/c bombarded a thin target of metallic Th^{232}. The

reaction products were recorded by four silicon detectors at an angle of 90° to the beam, consisting of two flight path detectors, a total absorption detector and an anticoincidence detector. The use of the two flight path detectors allowed double identification of each particle recorded. Secondary products were recorded in 8 energy intervals each 3 MeV wide and independently calibrated. In all, 2000 He^{8} nuclei were recorded. Standardized yields of the isotopes of helium produced in three different reactions are presented. The upper boundary of the cross section for formation of He^{10} was one-sixth as great as that expected on the basis of the Q_{gg} systematics of cross sections. Figures 3; references 11: 3 Russian, 8 Western.

[37-6508]

USSR

SEARCH FORLONG-LIVED HEAVY PARTICLES IN π^{-U}-INTERACTIONS AT 55 GeV/c

Moscow PIS'MA V ZHURNAL SKSPERIMENTAL'NOY I TEORETIC HESKOY FIZIKI Vol 30 No 6 20 Sep 79 pp 369-373 manuscript received 16 Jul 79

ANTINOV, YU. M., BEZZUBOV, V. A., BUDANOV, N. P., GORIN, YU. P., DENISOV, S. P., KLIMENKO, S. V., KOTOV, I. V., MIKHAYLOV, YU. V. LEVEDEV, A. A., PETRUKHIN, A. I., POLOBNIKOV, S. A., ROYNISHVILI, V. N. and STOYANOVA, D. A., Institute of High Energy Physics

[Abstract] Searching for heavy mesons with a lifetime of 10^{-12}-10^{-10}s, a study was made of the spectrum of effective masses of K systems formed in the reaction $\pi^{-U} \rightarrow K^{\pm} \pi^{\pm}+\ldots$ at 55 GeV/c. The experiment was performed on a o spectrometer. A beam of - mesons with a momentum of 55 GeV/c was focused on a uranium target 4 mm thick. The pulses of secondary particles leaving the target were measured by means of a spectrometric magnet and wire spark chambers. The diagram of the experimental installation is presented. The effective masses of $K\pi$ systems are illustrated for various values of distance between the center of the target and the restored peak of the $K\pi$ fork downstream from the magnet. Figures 3; References 5: 2 Russian, 3 Western.

[37-6508]

USSR

A NEW APPROACH TO DETERMINATION OF LEVELS OF ENERGY OF BOUND STATES IN QUANTUM MECHANICS: THE CONVERGING THEORY OF PERTURBATIONS

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI Vol 30 No 6 20 Sep 79 pp 379-383 manuscript received 20 Jul 79

TURBINER, A. V., Institute of Theoretical and Experimental Physics

[Abstract] This work undertakes the following tasks: construction of a theory of perturbations for the one-dimensional case, in which each term is expressed in quadratures, and which does not require knowledge of the entire spectrum of the unperturbed problem, and formation of a plan for selection of the unperturbed problem allowing achievement of a rapidly converging series in the theory of perturbations. It is emphasized that the method described can be used to perform studies of the spectra of various potentials rather simply, particularly calculating wave functions corresponding to the psectra in quantum mechanical one-dimensional problems. Obviously,the method can be used to study the strong force. This will be the subject of a subsequent work. References 3: 2 Russian, 1 Western.

[37-6508]

USSR

CALCULATION OF THE CROSS SECTION OF A MESON-MESON INTERACTION IN QUANTUM CHROMODYNAMICS

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI Vol 30 No 6 20 Sep 79 pp 383-386 manuscript received 22 Jul 79

BALITSKIY, YA. YA. and LIPASHOV, L. N., Institute of Nuclear Physics imeni B. P. Konstantinov, USSR Academy of Sciences

[Abstract] In an earlier work, the authors attempted to use quantum chromodynamics to describe the process of high-energy scattering of particles with charm. In this work, this description is extended to the case of particles consisting of light quarks. The ratio of duality between the scattering amplitude of photons and the ρ-meson amplitude is schematically imaged. Figure 1; references 7: 4 Russian, 3 Western.

[37-6508]

USSR

STUDY OF THE CHARACTERISTICS OF CUMULATIVE PROTONS UPON INTERACTION OF NEUTRINOS AND ANTINEUTRINOS IN A SCAT CHAMBER

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI Vol 30 No 6 20 Sep 79 pp 390-394 manuscript received 29 Jul 79

IVANILOV, A. A., KONYUSHKO, V. I., KORABLEV, V. M., KOROSHKOV, V. A., KUZNETSOV, YE. P., MAKEYEV, V. V., MYAGKOV, A. G., NIKITIN, YU. P., POLYARUSH, A. YU., SMIRNOV, YU. I., SOKOLOV, A. A. and BARANOV, D. S., Institute of High Energy Physics

[Abstract] The predictions of a number of models of the formation of cumulative protons (protons flying into a kinematic area forbidden for scattering on a free nucleon), produced in bundles of hedrons and gamma quanta, are described. Experimental data are presented, produced in the SCAT bubble chamber, on the formation of cumulative protons in the interaction of $\nu_\mu(\bar{\nu}_\mu$ with CF_3Br nuclei. No great suppression of the yield of cumulative protons is observed in neutrino experiments in comparison with hadro experiments. Figures 3; references 11: 4 Russian, 7 Western.

[37-6508]

USSR

ASYMPTOTIC SERIES IN QUANTUM-FIELD ASYMPTOTIC EXPANSIONS

Moscow TEORETICHESKAYA I MATEMATICHESKAYA FIZIKA in Russian Vol 40 No 3, Sep 79, pp 340-347 manuscript received 11 Jun 79

SHIRKOV, D. V., Joint Institute of Nuclear REsearch

[Abstract] For the past quarter century, ever since the discovery of the zero charge problem, the task of determination of ultraviolet asymptotic behavior in quantum field theory has been an important problem in mathematical physics. The most effective means for analysis of this problem has been the method of group renormalization, which reduces the problem of determination of ultraviolet asymptotic behavior to the solution of rather simple nonlinear differential equations. However, in spite of the hopes aroused by the discovery of this new method for producing information on asymptotic theories, the progress achieved by a decade of effort has been disappointing. We have learned to go beyond the weak coupling region to values of $g \simeq 1$, but this has been found insufficient to produce interesting physical results in realistic quantum-field cases. Further progress requires resolution of difficulties associated with the asymptotic nature of the expansions and, in the final analysis, a constructive solution in the region where $g \gg 1$. References 19: 9 Russian, 10 Western.

[22-6508]

USSR

AN ITERATIONAL METHOD OF SOLUTION OF THE EQUATIONS OF A QUASIPARTICLE-PHONON MODEL IN SPHERICAL NUCLEI

Moscow TEORETICHESKAYA I MATEMATICHESKAYA FIZIKA in Russian Vol 40 No 3, Sep 79, pp 422-428 manuscript received 13 Jul 78

STOYANOV, CH., Joint Institute of Nuclear Research

[Abstract] An iterational method is suggested alloiwng the equations of a quasiparticle-phonon model in spherical nuclei to be solved without any preliminary simplifications. This allows force functions in spherical nuclei to be calculated, corresponding to more complex wave functions of excitation of states than had been achievef earlier. The conditions of convergence are rather simple and are met in practical problems. References 15: 12 Russian, 3 Western.

[22-6508]

USSR

NEUTRON YIELDS IN SPONTANEOUS FISSION OF ^{252}Cf

Moscow YADERNAYA FIZIKA in Russian Vol 30, No 1(7), 1979 pp 36-43 manuscript received 27 Sep 78

ZAKHAROVA, V. P. and RYAZANOV, D. K., Institute of Atomic Energy imeni I. V. Kurchatov

[Abstract] Fission fragments that emit an increased number of neutrons are strongly deformed at the instant of separation. The total kinetic energy E_k of the pair of fragments is determined mainly by the potential energy of their mutual Coulomb repulsion. Previous research has shown a reduction in E_k in the region of mass symmetry and a corresponding increase in the number of neutrons emitted by such low-energy fragments pairs. In this paper a search is made for fragments that emit an increased number of neutrons in the region of mass symmetry at low values of E_k. The experiments were done with spontaneous fission of ^{252}Cf. The neutron yield from the fragments was determined as a function of the total kinetic energy of the fragment pair and the mass of one fragment. The fragments were registered by a dobule ionization chamber with grids. The instant of fission was determined by a photomultiplier from flares caused in the gas of the chamber by the fragments. The neutron detector was a plastic scintillator combined with the photomultiplier and placed cm from the center of the chamber. Regions of increased neutron yield were observed with

the following centers: M = 116-118 amu, E_k = 170 MeV; M = 156 amu, E_k = 140 MeV; M = 126-128 amu, E_k = 135 MeV. The authors thank Yu. S. Zamyatin and V. M. Strutinskiy for constructive criticism. Figures 4; references 11: 7 Russian, 4 Western.

[8-6610]

USSR

RELAXATION PHENOMENA THAT ACCOMPANY NUCLEAR FISSION

Moscow YADERNAYA FIZIKA in Russian Vol 30, No 1(7), 1979 pp 44-54 manuscript received 2 Aug 78

CHERDANTSEV, P. A., Scientific Research Institute of Nuclear Physics at Tomsk Polytechnical Institute

[Abstract] The process of relaxation to a compound nucleus is anlayzed as a diffusion process, which enables determination of the probability of collective deformation at any instant, and investigation of the influence that relaxation has on energy dissipation, and on the ratio of the neutron and fission widths of energy levels. No assumptions are made on the nature of collective motion. It is found that relaxation leads to redistribution of excitation energies, and therefore the instantaneous values of the widths of a state vary, leading to a change in the average widths. The ratio of the neutron and fission widths in the case of internal excitation may differe by an order of magnitude from the equilibrium statistical value. The dissipation of collective energy as heavy ions merge depends on excitation energy. In particular, relaxation time decreases exponentially with an increase in the energy of excitation. In this connection, when synthesizing superheavy elements it is important to select excitation energies that will provide adequate neutron widths without destroying the shell fission barrier. Figures 3; references 17: 3 Russian, 1 Polish, 13 Western.

[8-6610]

USSR

CHARACTERISTICS OF STRONGLY INELASTIC PROCESSES WITH NEUTRINO INTERACTION IN THE 2-30 GeV ENERGY REGION ON THE SKAT CHAMBER

Moscow YADERNAYA FIZIKA in Russian Vol 30, No 1(7), 1979 pp 146-148
manuscript received 24 Oct 78

BARANOV, D. S., VOLKOV, G. G., IVANILOV, A. A., KONYUSHKO, V. I., KORABLEV, V. M., KOROTKOV, V. A., KUZNETSOV, YE. P., MAKEYEV, V. V., MAGYAKOV, A. G., PARSHIKURA, S. N., POLYARUSH, A. YU., RYABOV, YU. G., SMIRNOV, YU. I., SOKOLOV, A. A., Institute of High Energy Physics, Serpukhov, and NIKITIN, YU. P., Moscow Engineering Physics Institute

[Abstract] In the neutrino beam of the Serpukhov High Energy Physics Institute on the SKAT chamber filled with freon bromide, 25,000 photographs were taken at an average proton intensity of $2 \cdot 10^{12}$ per accelerator cycle. Data are given on $\nu_\mu N$ interactions via charged currents (CC events) obtained in studying 555 events of the type $\nu_\mu + N \mu^- +$ hadrons. A relation is found for the mean square of the transmitted 4- momentum $\langle Q^2 \rangle$ as a function of the neutrino energy. Within the limits of experimental error, the findings do not contradict a linear increase in $\langle Q^2 \rangle$ with energy as predicted by a theory having the property of Bjorken scaling. The experimental data fit the curbe $\langle Q^2 \rangle = (0.2 \pm 0.1) + (0.25 \pm 0.02) E_\nu$. The authors thank L. D. Solov'yev and V. A. Yarbe for supporting the research, and also S. S. Gershteyn and S. P. Denisov for discussing the results. Figures 5; references 9: 7 Russian, 2 Western.

[8-6610]

USSR

THE ANTINEUTRINO-PROTON INTERACTION CROSS SECTION

Moscow YADERNAYA FIZIKA in Russian Vol 30, No 1(7), 1979 pp 149-152
manuscript received 4 Dec 78

BOROVOY, A. A., KETOV, S. N., KOPEYKIN, V. I., KHERUVIMOV, A. N. and SHKOL'NIK, K. D., Institute of Atomic Energy imeni I. V. Kurchatov

[Abstract] On the basis of recent data, an estimate is made of experimental and theoretical cross sections of the process of inverse β-decay of a neutron $\tilde{\nu}_e + p \rightarrow n + e^+$ discovered by F. Reines and C. L. Cowan Jr. [Phys. Rev. Vol 92, 1953, p 830]. An examination is made of possible reasons for the obserbed discrepancy between the calculated and measured cross sections for this interaction. In addition to statistical fluctuation

and errors of a procedural nature, discrepancies can be attributed to the accumulation of ^{239}Pu in the reactor and neutrino oscillations. The authors thank V. M. Galitskiy, V. G. Yerozolimskiy, A. G. Zelenkov, L. A. Mikaelyan and Ya. A. Smorodinskiy for constructive criticism. References 15: 4 Russian, 11 Western.

[8-6610]

USSR

P-ODD ASYMMETRY OF NEUTRON EMISSION IN FISSION OF ^{236}U

Moscow YADERNAYA FIZIKA in Russian Vol 30, No 2(8), 1979 pp 306-312
manuscript received 27 Sep 78

ANDREYEV, V. N., DANILOV, M. M., YERMAKOV, O. N., NEDOPEKIN, V. G. and ROGOV, V. I., Institute of Theoretical and Experimental Physics, State Committee on Utilization of Atomic Energy

[Abstract] Fission neutrons are emitted chiefly in the direction of motion of the fragments, approximately twice as many neutrons being emitted in the direction of motion of the lighter fragment. This anisotropy has a considerable effect on fission neutron energy. It can be concluded that P-odd asymmetry in fragment dispersal involves P-odd asymmetry in neutron emission, assuming the parity-violating forces do not change the neutron yield from the fragments. Thus it is expected that the measured P-odd asymmetry a_n of fission neutron yield will be $a_n = \eta a_f k$ where a_f is the P-odd asymmetry of fragment dispersal, and η is a coefficient that accounts for the anisotropy of fission neutron yield, the efficiency of registration of neutrons of different energies and the geometry of the experiment. The P-odd asymmetry of emission of fission neutrons is measured for ^{236}U fission. The measurements are made with and against the direction of nucleus polarization. Polarized ^{236}U nuclei were obtained by capture of polarized thermal neutrons. The measured asymmetries are given for four energy ranges of the recoil neutrons. The averaged asymmetry is $(0.7 \pm 0.4) \cdot 10^{-5}$. The results are compared with analogous results for ^{240}Pu, and also with the P-odd asymmetry of fragment dispersal in fission of ^{235}U and ^{239}Pu by polarized thermal neutrons. It is concluded that the forces responsible for non-conversation of parity in the fission process influence the ratio of intensities of neutrons in the direction of the light and heavy fragments, reducing this ratio in the case of ^{236}U, and increasing it for ^{240}Pu. The authors thank V. V. Vladimirskiy for interest in the work, and also Yu. D. Katarzhnov for assistance with the measurements. Figures 5; references 7: 6 Russian, 1 Western.

[188-6610]

USSR

SEARCH FOR NEUTRONS WITH ENERGY GREATER THAN 40 MeV IN FISSION

Moscow YADERNAYA FIZIKA in Russian Vol 30, No 2(8), 1979 pp 313-317
manuscript received 11 Dec 78

POPOV, A. B. and SAMOSVAT, G. S., Joint Institute of Nuclear Research

[Abstract] The search for superdense nuclei has been limited by the level of the cosmic background. Further improvement of measurement sensitivity has involved use of greater intensity of fissions with a corresponding increase in the speed of equipment, and also suppression of the background. This paper describes measurements in which the upper level of the yield of very fast neutrons is lowered by a factor of 50 by using the method of anticoincidences to suppress the background of cosmic particles. The anticoincidence scintillation detector was installed in the beam of the IBR-30 pulse reactor, and the time-of-flight technique was used to find neutrons of anomalously high energies to confirm the formation of superdense nuclei in the reactor core with elevated binding energy. The results show that the neutron yield with energies in the range of 40-400 MeV is less than $2\cdot10^{-8}$ per act of fission of reactor fueld (75% ^{239}Pu and 25% ^{235}U) by fast neutrons. The authors thank I. M. Frank for interest in the work, Ye. N. Matveyeva for furnishing the scintillator, V. G. Nikolenko for constructive criticism, and A. A. Loshkarev for making the detector. Figures 1; references 5: 4 Russian, 1 Western.

[188-6610]

USSR

INVESTIGATION OF THE REACTION π^- p $\to$'n IN THE 15-40 GeV/c MOMENTUM RANGE

Moscow YADERNAYA FIZIKA in Russian Vol 30, No 2(28), 1979 pp 366-372
manuscript received 11 Mar 79

APEL, W. D., AUGENSEIN, K. H., KRUGER, M., MÜLLER, H., SCHNEIDER, H., Institute of Experimental Nuclear Physics, University and Nuclear REsearch Center [IENP], Karlsruhe, West Germany, BERTOLUCCI, E., VINCELLI, N. L., QUAGLIA, M., PIERAZZINI, G. M., SERGIAMPIERI, F., SCRIBANO, A., Institute of Physics, University and INFN, Pisa, Italy, DONSKOV, S. V., INYAKIN, A. V., KACHANOV, V. A., KRASNOKUTSKIY, R. I., LEDNEV, A. A., MIKHAYLOV, YU. V., PROKOSHKIN, YU. D., SHUVALOV, R. S., Institute of High-Energy Physics [IHEP], Serpukhov, USSR, JOHNSON, R., IHEP, visitor from Lawrence Laboratories, Berkley, now at Fermilab, Batavia, United States, KITTENBERGER, W., LEDER, G., STEUER, M., Institute of High-Energy Physics and AAN, Vienna, Austria, SIGURDSSON, G., SCHINZEL, D., IENP, Karlsruhe, CERN, Geneva, Switzerland, and MANNELLI, I., Institute of Physics, University of INFN, Pisa, CERN, GENEVA

[Abstract] The authors measure the production corss sections η'-mesons

in collisions between π^--mesons and protons: $\pi^- + p \to \underset{\hookrightarrow 2\gamma}{\eta'}(958) + n$ at five values of the π^--meson momenta ranging from 15 to 40 MeV. The experiments were done on the 70 GeV accelerator at the Serpukhov High-Energy Physics Institute, using the NICE 64`-channel hodoscopis spectrometer. There were 6000 η' registrations. An abrupt drop is observed in the differential cross section as $t \to 0$. The t-dependences of the differential cross sections are the same for the reactions $\pi^- p \to \eta' n$ and $\pi^- p \to \eta n$. The ratio of these cross sections at t=0 is $R(\eta'/\eta)_{t=0} = 0.55 \pm 0.06$. From this ratio, the authors determine the singlet-octet mixing angle for pseudoscalar mesons $\beta = -(18.2 \pm 1.4)^\circ$. Figures 4; references 15: 5 Russian, 10 Western.

[188-6610]

USSR

INVESTIGATION OF THE REACTION $\pi^- p$ $\pi^0 n$ IN THE 15-40 GeV/c MOMENTUM RANGE

Moscow YADERNAYA FIZIKA in Russian Vol 30, No 2(28), 1979 pp 373-382
manuscript received 27 Mar 79

APEL, W. D., AUGENSTEIN, K. H., KRÜGER, M., MÜLLER, H., SCHNEIDER, H., Institute of Experimental Nuclear Physics, University and Nuclear Research Center [IENP], Karlsruhe, West Germany, BERTOLUCCI, E., VINCELLI, N. L., QUAGLIA, M., PIERAZZINI, G. M., SERGIAMPIETRI, F., SCRIBANO, A., Institute of Physics, University and INFN, Pisa, Italy, DONSKOV, S. V., INYAKIN, A. V., KACHANOV, V. A., KRASNOKUTSKIY, R. N. LEDNEV, A. A., MIKHAYLOV, YU. V., PROKOSHKIN, YU. D., TOROPIN, A. N., SHUVALOV, R. S., Institute of High-Energy Physics [IHEP], Serpukhov, USSR, JOHNSON, R., IHEP, visitor from Lawrence Laboratories, Berkley, now at Fermilab, Batavia, United States, LEDER, G. , STEUER, M., nstitute of High-Energy Physics and AAN, Vienna, Austria, SIGURDSSON, G., SCHINZEL, D., IENP, Karlsruhe, CERN, Geneva, Switzerland, and MANNELLI, I., Institute of Physics, University and INFN, Pisa, CERN, Geneva

[Abstract] An experimental study is made of the reaction $\pi^- + p \to \underset{\hookrightarrow 2\gamma}{\pi^0} + n$ with high statistical accuracy at momenta up to 40 GeV/c over a broad range of transmitted 4-momenta t. The experiments were done on the 70 GeV accelerator at the Serpukhov High-Energy Physics Institute, using the NICE 648-channel hodoscopic spectrometer. About $3 \cdot 10^6$ π^0-mesons were registered. An amplitude analysis is made of the reaction at small $|t|$, showing that the scattering amplitudes with and without spin flip are parametrized by exponential functions with slopes that are identical to within a few percent. The t-dependence of the differential cross section for intermediate and large $|t|$ agrees with the geometric s-channel approximation. The imaginary part of the universal pole $\mathrm{Im}b_0(s)$ is

determined. A logarithmic increase in Imb$_0$(s) is observed with increasing energy. Figures 9; references 17: 4 Russian, 13 Western.

[188-6610]

USSR

RESULTS OF INVESTIGATION OF THE POSITION OF THE MAXIMUM AND ITS FLUCTUATIONS FOR EXTENSIVE AIR SHOWERS WITH ENERGY $E_0 > 2\cdot10^{16}$ eV BY THE METHOD OF REGISTRATION OF THE SHAPE OF CHERENKOV PULSES

Moscow YADERNAYA FIZIKA in Russian Vol 30, No 2(8), 1979 pp 415-423 manuscript received 2 Nov 78

BEREZHKO, I. A., GRIGOR'YEV, V. M., YEFIMOV, N. N., KALMYKOV, N. N., NECHIN, YU. A., PROSIN, V. V., FOMIN, YU. A. and KHRISTIANSEN, G. B., Scientific Research Institute of Nuclear Physics, Moscow State University

[Abstract] A new method fo getting information on longitudinal development of extensive air showers in the atmosphere is to study the shape of Cherenkov light pulses. The method is based on the one-to-one correspondence between the number of particles in the shower at a given level in the atmosphere and the number of photons of Cherenkov radiation registered in the corresponding time interval at a certain distance from the axis of the shower. This paper gives the results of an experimental study by this technique on the Yakut EAS facility, and also the results of calculations enabling evaluation of the feasibility of the method for studying superhigh-energy cosmic rays. The average depth of the maximum is found, and its dependence on E_0. Based on fluctuations of the depth of the maximum, an upper limit is found for the mean free path of interaction of primary particles. Figures 5; references 6 Russian.

[188-6610]

USSR UDC: 537.533

OSCILLATIONS OF SPACE CHARGE IN AN INHOMOGENEOUS FLUX OF RELATIVISTIC ELECTRONS

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 29 No 8, Aug 79 pp 1654-1658 manuscript received 28 Feb 78; after editing, 18 Dec 78

PRIVEZENTSEV, A. P., FILIPENKO, N. M. and FOMENKO, G. P., Scientific Research Institute of Nuclear Physics at the Tomsk Polytechnic Institute imeni S. M. Kirov

[Abstract] The effect of the potential sag due to Coulomb forces on the space-charge wave spectrum of a relativistic electron flux bounded by two ideally conducting planes is considered for the case in which the electrons move along a strong magnetic field. An equation of the potential is derived by the iterative method. The first harmonics of fast and slow waves are computed. It is shown that sag of the potential results in a slowdown of space-charge waves, which is qualitatively attributable to the decrease in the mean electron velocity in the flux. In the relativistic case the phase velocity of the slow space-charge waves markedly decreases owing to the transverse inhomogeneity of the flux. As for the spectrum of the fast waves, in this case it changes insignificantly. These findings are of interest in connection with the currently conducted experiments with heavy-current relativistic electron beams. Figures 2; references 5: 3 Russian, 2 Western.

[32-1386]

USSR UDC: 621.384.643

SELECTING THE PARAMETERS OF RESISTANCE COATINGS FOR ACCELERATING TUBES IN PULSED ACCELERATORS

Leningrad ZHURNAL TEKHNICHESKOY FIZIKA in Russian Vol 49 No 8, Aug 79 pp 1739-1741 manuscript received 22 Mar 78; after editing, 4 Sep 78

ZAKUTIN, V. V. and SHENDEROVICH, A. M.

[Abstract] Resistance coatings are used to remove scattered electrons reaching the walls of the dielectric electron guide in pulsed electron accelerators. The parameters of such coatings should be selected with allowance for their temperatures and for the absorption of the electromagnetic field. In addition, in accelerators with short pulse duration, in which electrodynamic effects are important, allowance should also be made for the reflection of the electromagnetic waves, excited in the

accelerating structure, when they strike the coatings. A formula showing that under certain conditions the resistance coating does not weaken the accelerating electrical field along the accelerator's axis is derived. Estimates based on this formula show that the thickness requirements of metal coatings virtually cannot be satisfied. The use of high-resistivity oxide coatings, on the other hand, may only slightly weaken the accelerating field. Figure 1; references 3: all Russian.

[32-1386]

USSR UDC: 621.384.6

POTENTIAL OF A TUBULAR ELECTRON BEAM FORMED IN A MAGNETICALLY INSULATED DIODE

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 49 No 8, Aug 79
pp 1790-1792 manuscript received 2 Nov 78

BUGAYEV, S. P., KIM, A. A. and KOSHELEV, V. I., Tomsk, Institute of Heavy-Current Electronics, Siberian Affiliate of the USSR Academy of Sciences

[Abstract] The use of heavy-current tubular electron beams formed in magnetically insulated diodes requires knowledge of the beam potential. To this end, measurements of the potential were conducted for the first time, in a microsecond accelerator. During the first series of experiment the potential and current of the beam were measured and it was found that the beam current is determined by the acceleration zone in the diode rather than by the capacity of the drift tube, and measured values of thepotential differed from their theoretical counterparts by not more than 10%. During the second series of experiments the propagagion rate of cathodic plasma along the magnetic field was found to be $2-3\cdot10^7$ cm/sec, which is nearly two orders of magnitude higher than thepropagation rate across the field. A notheworthy property of magnetically insulated diodes is that they can be used to form electron beams of varying potential in the presence of a fixed diode voltage ($\sim 10^5$ v). Figure 1; references 9: 8 Russian, 1 Western.

[32-1386]

USSR UDC: 621.372.82

THEORY OF OPTICAL WAVEGUIDES WITH A PLANE-LAYERED SUBSTRATE

Minsk DOKLADY AKADEMII NAUK BSSR in Russian Vol 23, No 5, 1979 pp 413-416
manuscript received 6 Jun 78

GONCHARENKO, A. M., associate member of the Belorussian Academy of Sciences and MAXANIK, L. A., Mogilev Division, Institute of Physics, Belorussian Academy of Sciences

[Abstract] The use of heterogeneous plane-layered multi-layer structures permits variation and alteration of the properties of optical waveguides. Multi-layer periodic structures can be used for waveguide propagation of light, even in optically less dense media. From the practical standpoint, this is interesting because it is not always easy to select the necessary materials for waveguide cores and envelopes. Acoustic waves can be used to modulate waveguide substrates in integrated optics devices to alter waveguide properties and thereby control waveguide parameters. An optical waveguide with substrate whose permittivity is transversely modulated is considered. If a uniform layer is surrounded on both sides by a modulated medium, its waveguidance increases because a structure is formed which has greater symmetry of profile of refractive index. Figures 2; references 5: 3 Russian, 2 Western.

[3-8617]

USSR UDC: 535.373.2

RESONANT SECONDARY LUMINESCENCE OF EXCITONS

Moscow IZVESTIYA AKADEMII NAUK `SSR, SERIYA FIZICHESKAYA in Russian Vol 43, No 6, Jun 79 pp 1278-1283

KLOCHIKHIN, A. A. and PERMOGOROV, S. A., Physicotechnical Institute imeni A. F. Ioffe, Academy of Sciences USSR

[Abstract] The authors discuss the mechanisms of arisal and the principles of classification of secondary luminescence with excitation of semiconductor crystals by monochromatic light with energy close to exciton resonance. It is shwon that the way that different components of secondary luminescence (resonant Raman scattering and exciton-phonon luminescence) arise can be descrived on the basis of a unified model that considers sequential scattering of light-stimulated intermediate states by phonons. Spectra of secondary luminescence of CdS and ZnTe crystals are examined.

It is shown that the intermediate states of secondary luminescence may be states of the discrete or continuous spectrum of excitons, depending on the actual region of energies and the crystal parameters. The authors thank Ya. V. Morozenko, A. N. Reznitskiy and V. V. Travnikov of the Physicotechnical Institute who took part in getting the results used in this work. Figures 3; references 8: 7 Russian, 1 Western.

[10-6610]

USSR UDC: 535.37

SPECTRAL-KINETIC PROPERTIES OF LUMINESCENCE AND GENERATION OF SUBNANOSECOND LIGHT PULSES IN $A^{II}B^{VI}$ SEMICONDUCTORS

Moscow IZVESTIYA AKADEMII NAUK SSSR SERIYA FIZICHESKAYA in Russian, Vol 43, No 8, 1979, pp 1783-1786

BOYKO, G. A., DNENROVSKIY, V. S., ZHUKOV, YE. A., KLIMOV, V. I., PENDYUR, S. A., SILINA, YE. K., TALENSKIY, O. N., FOKIN, V. S. and CHUMASH, V. N., Moscow State University imeni M. V. Lomonosov

[Abstract] Spectral-time studies of the states of high density excitons by methods of dynamic semiconductor spectroscopy are quire important today. In this work, a special laser spectrographic installation was used for this purpose, consisting of a spectrograph crossed with a high speed photo electronic recorder (type FER-2) with a time resolution of 20 os, a neodymium laser in the ultrashort pulse mode, an optical delay line and a synchronization circuit. In order to increase the dynamic range of the recording system and allow more rapid processing of the results of time measurements, a dynamic photometry system was used, based on a type LI-602 slit dissector. The specimen being studied was placed in an optical helium cryostat or directly in liquid nitrogen. A wide variety of crystals can be used, achieving subnanosecond lasing throughout the visible change of light, as well as the near ultraviolet and infrared regions of the spectrum. Figures 4; references 16: 8 Russian, 8 Western.

[21-6508]

USSR UDC: 534.23:534.29:539.166

INTENSITY OF ULTRASONIC SATELLITES OF THE MOSSBAUER SPECTRUM AS DEPENDENT ON THE STATISTICS OF A SONIC FIELD

Tomsk IZVESTIYA VYSSHIKH UCHEBYKH ZAVEDENIY FIZIKA in Russian, No 7(206), 1979, pp 54-47, manuscript received 30 May 78

SADYKOV, E. K. and DUDKIN, V. A., Kazan' State University imeni V. I. Ul'yanov-Lenin

[Abstract] The gamma resonance spectra are calculated considering processes of dissipation, and a general equation is derived for the intensity of ultrasonic satellites. The intensity of satellites is expressed through the parameters m and σ which are independent of the degree of coherence of the sound. Determination of the parameters m and σ allows one to study not only the degree of excitation of sound in a specimen, but the statistics of the sonic field. Figure 1; references 10: 7 Russian, 3 Western.

[18-6508]

USSR UDC: 535

THE QUESTION OF THE NATURE OF DISTRIBUTION OF INTENSITY IN A REFRACTED BEAM FORMED OF RAYS MOVING INITIALLY ALONG THE INTERFACE BETWEEN TWO OPTICALLY HOMOGENEOUS MEDIA. I

Tomsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY FIZIKA in Russian, No 7(206) 1979, pp 112-115, manuscript received 12 Apr 78

TERENT'EV, YU. I., Institute of Optics of the Atmosphere, Siberian Branch, USSR Academy of Sciences

[Abstract] This work is a continuation of studies of the refraction of slipping rays of light transmitted through the dispersion zone of an optically less dense medium above the interface between two homogeneous media. Its purpose is to determine the factors which define the distribution of intensities of rays in the refracted bundle of rays and its divergence. The distribution of intensity is found to be determined by interference of refracted rays from the surface of the interface boundary. Figure 1; reference 1 Russian.

[18-6508]

USSR UDC: 539.184.26

OPTICAL SELF-PUMPING OF THALLIUM IN A DISCHARGE

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian, Vol 46, No 6, Jun 79
pp 1061-1066, manuscript received 23 Dec 78

ALEKSANDROV, YE. B., BEZUGLOV, N. N. and YAKOBSON, N. N.

[Abstract] For 20 years, it has been known that there is an anomaly in the intensities of components of the hyperfine structure of the resonant lines of thallium in a gas discharge, assumed to be a result of a population inversion. This article presents detailed results of aradiospectroscopic experiment, indicating that the anomaly of hfs intensities exists even when there is no population inversion. A universal mechanism of development of differences in populations of sublevels of metastable states in a gas discharge is described. This self-pumping occurs in systems with metastable sublevels of multiplet terms, the nature of the process depending not only on the statistical weights of the sublevels, but also on their energies and the temperature of the electrons in the discharge. The population of many excited states of atoms in the discharge is found to depend on the mutual orientation of the electronic and nuclear components in the ground state. This relationship arises due to processes of radiation transfer, although transitions to the ground state may indirectly influence electron concentration. Figures 5; references 10: 8 Russian, 2 Western.

[170-6508]

USSR UDC: 539.186.2:546.295

EXCITATION OF THE INFRARED LINES OF Xe I BY LOW-ENERGY ELECTRONS

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian, Vol 26, No 6, Jun 79,
pp 1121-1124 manuscript received 14 Dec 78

BOROZDIN, V. S. and SMIRNOV, YU. M.

[Abstract] A study is made of the excitation if IR lines of xenon by an electron gun modulated by square pulses at a frequency selected to be the optimal for the photodetector used. The optical radiation was recorded by synchronous detection of themodulated signal as the electron energy was automatically varied from 50 eV to the threshold of excitation over a period of approximately 1 hour. Graphs of the excitation functions are presented. The error in measurement of the shape of the functions is not over 5% of the maximum value for the strong lines, 10% for the

weaker lines. Preliminary estimates indicate that the cross sections of excitation of the shortest lines are approximately 10^{-18} cm^2. Figures 4; references 5: 2 Russian, 3 Western.

[170-6508]

USSR UDC: 535.34-15+621.373:535

LASER SPECTROSCOPY WITH AN OPTICAL-THERMAL RECEIVER

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 46, No 6, Jun 79, pp 1169-1172, manuscript received 9 Nov 78

HARTUNG, K. and TURHEIT, R., Central Institute of Optics and Spectroscopy, East German Academy of Sciences

[Abstract] Earlier, the authors attempted to find the proportionality between optical-thermal signals and the absorption coefficient in the transition area between high and low pressures of the gas studied. It was impossible, due to equipment limitations, to demonstrate the optical-thermal work at a pressure such that there are clearly no collisions between particles. In this work, the ceramic pyrodetector was replaced with PVF:2 foil, which has greater sensitivity. The absorbing gas used was SF_6, and the variation of the optical-thermal detector signal with SF_6 pressure was recorded in the range of pressures of 1 to 150 mtorr at the center of the P(16) lines of a CO_2 laser. The measurements indicate the possibility of using optical-thermal detectors at both high and low pressures of the gas being studied. The coefficients of absorption of water vapor were measured. Differences with earlier works are probably explained by the insufficient resolution of the spectrometer. Figures 2; references 10: 4 Russian, 6 Western.

[170-6508]

USSR UDC: 621.373:535+535.33

STUDY OF THE SPECTRA OF SPONTANEOUS RADIATION OF A NEON-HELIUM TRAVELING-WAVE LASER OPERATING IN THE 3.30 µm REGION

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian, Vol 46, No 6, Jun 79, pp 1173-1176 manuscript received 8 Dec 78

ZMIYEVSKIY, G. N., MAZAN'KO, I. P. and SVIRIDOV, M. V.

[Abstract] The method of optical beats was used to study the spectra of spontaneous radiation of a traveling-wave laser operating at 3.39 µm ($3s_2$-$3p_4$ transition of Ne). The spectra of spontaneous radiation were recorded in two heterodyne frequency scanning modes: slow, period 100-1000 s, and fast, period 0.1-1 s. The spontaneous radiation accumulated in a resonator may significantly influence the statistical characteristics of neon-helium lasers operating in this wavelength range. Figures 5; references 6: 4 Russian, 2 Western.

[170-6508]

USSR UDC: 535.33+535.317.1

THE PRODUCTION AND POSSIBLE APPLICATIONS OF HOLOGRAM SPECTRA

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 46 No 5, Jun 79 pp 1196-1200, manuscript received 14 Dec 78

ZHIGLINSKIY, A. G., KUND, G. G. and MOROZOV, A. O.

[Abstract] A method is suggested for spectroscopic studies allowing, in principle, recording of information on the amplitude, phase and polarization of a light wave, as well as the spatial distribution at various frequencies. The method differs from traditional spectroscopic methods in that the radiation of the line spectrum source is divided by amplitude into 2 beams, with the object being studied placed into one the beams), then both beams enter the spectrograph. A hologram spectrum is thus recorded in the focal plane. When thishologram is reproduced, information can be obtained concerning all of the macroscopic parameters of the wave studied, combining the advantages of spectroscopic measurement and holography. The possibility is noted of holography of a multicomponent plasma simultaneously at several wavelengts to allow separate study of the individual components of the plasma or different states of atoms of one type. Figures 5; references 7 Russian.

[170-6508]

USSR UDC: 539.184.28

THE ZEEMAN EFFECT IN FINE STRUCTURAL LEVELS OF A HYDROGEN-LIKE ATOM

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 47 No 1, Jun 79 pp 18-26
manuscript received 28 Jun 78

ZAPRYAGAYEV, S. A.

[Abstract] Analytic equations are derived for Zeeman spliting of levels of the fine structure of hydrogen-like atoms with arbitrary values of the principla quantum number, by solution of the Dirac equation in a Coulomb field. Lamp shift and the hyperfine structure of the levels are considered. Figures 2; references 18: 5 Russian, 13 Western.

[169-6508]

USSR UDC: 533.9

SPECTROSCOPY OF ^{3}He-Hg AND ^{3}He-Kr-Hg HIGH PRESSURE PLASMAS EXCITED BY THE PRODUCTS OF THE REACTION ^{3}He(n,p) T

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian Vol 47 No 1, Jul 79 pp 63-66
manuscript received 8 Sep 78

DMITRIYEV, A. B., IL'YASHENKO, V. S., MIS'KEVICH, A. I. and SALAMAKHA, V. S.

[Abstract] A study is made of the luminescence spectra of Hg I and Hg II in an ^{3}He-Hg and an ^{2}He-Kr-Hg plasma at a pressure of about 1 atm, excited by the reaction ^{3}He(n,p)T. The gas mixtures were contained in sealed glass cuvettes 30 mm in diameter x 150 mm in length with a window at the end made of radiation-resistant cerium glass. The studies showed that in ^{3}He-Hg and ^{3}He-Kr-Hg mixtures at high pressure, excited by strongly ionizing particles, the 7^3S_1 level of Hg I is primarily populated. The population of the $7^2P_{3/2}$ level of Hg II is several orders of magnitude lower, making it possible to achieve lasing on the ionic transition of mercury with high efficiency by means of nuclear pumping. Figures 2; references 11: 3 Russian, 8 Western.

[169-6508]

USSR UDC: 535.33-31

OBSERVATION OF THE CONTINUOUS RADIATION SPECTRUM OF THE ArXe MOLECULE WITH INTENSITY MAXIMUM AT λ= 1590 A

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian, Vol 47 No 1 Jul 79, pp 204-207, manuscript received 29 Sep 78

VERKHOVTSEVA, E. T. and OVECHKIN, A. YE.

[Abstract] A search was made for the continuous spectrum of radiation of the ArXe molecule in a gas-jet vacuum ultraviolet source. The emission spectra of an Ar-Xe mixture were studied with various phase compositions of the jet over a broad range of change of concentrations of impurities. The spectrum with λ_{max} = 1590 A is much less intense than the radiation of its analogues - the continuous spectra with λ_{max} = 1350 and 1545 Å, as well as the spectra of the matrix λ_{max} = 1270 Å and impurities λ_{max} = 1750 Å. Figures 2; references 10: 1 Russian, 9 Western.

[169-6508]

USSR

ANISOTROPY OF CAPTURE OF 29 cm^{-1} PHONONS IN RUBY

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI Vol 30 No 5 Sep 79 pp 275-279 manuscript received 17 Jul 79

BASUN, S. A., KAPLYANSKIY, A. A. and SHEKHTMAN, V. L., Institute of Physics and Technology imeni A. F. Ioffe, USSR Academy of Sciences

[Abstract] A report is presented on experimental detection of a new mechanism of operation of captured radiation, related essentially to the anisotropy of the system. A study of capturing of phonons was performed on oreinted Al_2O_3 single crystals containing 0.02 at % Cr at t = 1.8 K. It was found that the capture factor in the extended cylindrical volume was anisotropic. The experiments indicate that there is a certain specific "anisotropic" channel for departure of 29 cm^{-1} phonons from the excited volume. The "anisotropic" capture mechanism is similar to the capture mechanism of Holstein and Biberman: in both cases, as a result of repeated scattering, the radiation is transformed to poorly absorbed modes, which leave the depth of the volume without reabsorption. Figures 2; references 11: 6 Russian, 5 Western.

[36-6508]

USSR

OBSERVATION OF COOPERATIVE EFFECT IN RAMAN SCATTERING

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKA Vol 30 No 6 20 Sep 79 pp 342-345 manuscript received 7 Aug 79

PIVTSOV, V. S., RAUMUAN, S. G., SAFONOV, V. P., FOLIN, K. G. and CHERNOBROD, B. M., Institute of Automation and Electrometry, USSR Academy of Sciences, Siberian Division

[Abstract] A study was made of Q_{01} of a Raman scattering line in H_2, $\Delta\omega = 4.55.2\ cm^{-1}$. A ruby laser served as the source of exciting radiation. The primary result of the experiment is detection of a significant delay of Stokes and anti-Stokes pulses relative to the maximum of the exciting pulse. A delay and existence of a time structure are in qualitative agreement with the predictions of the theory of cooperative Raman scattering. Figure 1; references 12: 5 Russian, 7 Western.

[37-6508]

USSR

DIFFRACTION OF CHERNKOV RADIATION IN A SPATIALLY PERIODIC MEDIUM

Moscow ZHURNAL ESKPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 26 No 3, Mar 79 pp 866-872 manuscript received 26 Jul 78

FEDOROV, V. V. and SMIRNOV, A. I., Leningrad Institute of Nuclear Physics, Academy of Sciences USSR

[Abstract] Diffraction of light in a medium with spatially periodic distribution of the index of refraction is analogous to x-ray diffraction in a single crystal. A holographic space lattice is one example of such a medium, with permittivity depending on coordinate according to the law $\varepsilon = \varepsilon_0 + 2\varepsilon_g \cos gr$, where g is the reciprocal lattice vector, $|g| = 2\pi/d$, d is the space period). Another example is a laminar medium with layers having different permittivities. When a charged particle moves in such a medium, Cherenkov radiation arises, and also transitional radiation due to pulse absorption or reflection by the periodic medium at multiples of hg. The authors consider the diffraction particulars of a particle moving in a periodic medium along planes $\varepsilon =$ const, i. e. perpendicular to vector g. In this case there is no transitional radiation, and the reflectec Cherenkov cone coincides with the main cone. It is shown that diffraction leads to discontinuities of the surface of the Cherenkov cone that reflect

the presence of two branches of the dispersion surface of a photon in the periodic medium. A position of these discontinuities on the Cherenkov cone at a given photon frequency is strongly dependent on the velocity of the particle, which in principle can be utilized for mass separation of ultrarelativistic particles. The results are readily generalized to the case of arbitrary motion of a particle, both Cherenkov and transitional radiation being due to a certain form of the refractive index for photons in the periodic medium. The authors thank O. M. Sumbayev, V. A. Ruban and A. S. Ryl'nikov for constructive criticism, and also L. N. Kondurova for doing thenumerical calculations. Figures 4; references 8: 7 Russian, 1 Western.

[98-6610]

USSR

TWO-STATE PHOTO-IONIZATION OF HELIUM VIA THE EXCITED STATE $4p^1P_1$

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 26 No 3, Mar 79 pp 873-886 manuscript received 21 Jul 78

AMUS'YA, M. YA., AFROSIMOV, V. V., BELIK, V. P., BOBASHEV, S. V., SHEYNERMAN, S. A. and SHMAYENOK, L. A., Physicotechnical Institute imeni A. F. Ioffe, Academy of Sciences USSR

[Abstract] A new technique is proposed for experimental investigation of processes of photoionization of atoms from short-lived states with excitation energy corresponding to the vacuum ultraviolet region of the spectrum. The procedure is based on using vacuum ultraviolet radiation of a laser plasma for preparing excited atoms. The process of two-step photoionization of thehelium atom is studied. It is shown that the photoionization cross section of the excited state is not described by the Coulomb approximation, and requires the use of the more precise Hartree-Fock wave functions. The cross section σ_{4p} of ionization from excited state $4p^1P_1$ was measured. It is found that this cross section is of the order of 10^{-17} cm^2 with minimum error of 60%. A theoretical analysis is made of processes of two-step resonant photoionization in one-electron approximations and with consideration of correlations of atomic electrons. The calculation in the Hartree-Fock approximation agrees satisfactorily with the experimental results, whereas the Coulomb approximation gives a value three times the experimental result. Figures 6; references 36: 21 Russian, 15 Western.

[98-6610]

USSR

INTERACTION OF ATOMS IN A LIGHT FIELD

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 26 No 3 Mar 79 pp 896-907 manuscript received 7 Sep 78

ZHUKOVA, N. I., KAZANTSEV, A. P., KAZANTSEV, E. F. and SOKOLOV, V. P., Institute of Theoretical Physics imeni L. D. Landua, Academy of Sciences USSR

[Abstract] A study is done on the interaction of like atoms in a resonant light field. An examination is made of the two limiting cases of short and long distances between particles relative to the resonant wavelength. Analysis of the adiabatic potentials in the near zone shows that the interaction potential in a light field takes the form of a potential well with parameters that depend on field strength. Therefore the atoms may form quasimolecules with larger dimensions than those of the atoms themselves. For a strong field of the order of 10^6 V/cm the depth of the well is about 100 C and the size is about 10 Å, with about 100 bound states. It should be possible to observe these states experimentally as a fine structure in studying the Stark shift of levels in gases. In the case of a field as weak as 1 V/cm the size of the well becomes comparable with a wavelength, and the depth decreases to about 10^{-4} C. The lifetime of a quasimolecule in such states may be much longer than that of an atom in the excited state, and this may be of use in spectroscopy of narrow atomic and molecular resonances. In studying long-range interaction of atoms it is shown that this interaction agrees with Coulomb law, while the effective charge depends on field and on the velocities of the atoms. In weak fields the atoms repel each other, while in strong field both attraction and repulsion may take place. In a gas of finite density, the force of interaction between atoms and other particles may be comparable to the force of light pressure. This could be important in studying the kinetics of atoms in a resonant field. Of interest in this connection is an experiment showing anomalous distribution of gas under the pressure of light [see J. E. Bjorkholm, A Ashkin, Phys, Rev. Lett., Vol 32, p 129, 1974]. It is pointed out that particles can exchange both photons and phonons. This may also lead to long-range forces. It is possible that forces of this kind play some part in the interaction of protein molecules. Figures 2; references 16: 12 Russian, 4 Western.

[98-6610]

USSR

EXPERIMENTAL STUDY OF POSSIBILITIES FOR USING WAVEFRONT REVERSAL WITH INDUCED MANDELSTAM-BRILLOUIN SCATTERING

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 26 No 3, Mar 79 pp 908-924 manuscript received 18 Sep 78

DOLGOPOLOV, YU. V., KOMAREVSKIY, V. A., KORMER, S. B., KOCHEMASOV, G. G., KULIKOV, S. M., MURUGOV, V. M., NIKOLAYEV, V. D. and SUKHAREV, S. A.

[Abstract] An investigation is made of the feasibility of using wavefront reversal with induced Mandelstam-Brillouin scattering by photodissociation laser emission to solve problems of laser-driven fusion, specifically for decoupling amplification stages, tailoring pulses and other problems. The experimental research is doen mainly in the steady-state scattering mode where the duration of the laser pulse is much longer than the lifetime of acoustic phonons. The operation of an iodine amplifier with Mandelstam-Brillouin wavefront reversal is studied with pumping pulse duration of 5-10 us handling weak input signals with intensity of the order of 10^{-3} W/cm^2, achieving a gain of about 10^6 per pass. Particular attention is given to quantitative determination of the characteristics of the degree of reproduction of the pumping beam and the compensation of optical inhomogeneities of the laser medium, and also to finding the conditions under which such inhomogeneities are observed. The range of pumping intensities in which complete reproduction of the angular spectrum is realized is experimentally determined. It is found how compensation accurach depends on the degree of reproduction of the angular spectrum. Figures 12; references 44: 37 Russian, 7 Western.

[98-6610

USSR

ZERO-POINT EFFECT WHEN LIGHT IS MODULATED IN A FABRY-PEROT INTERFEROMETER

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 26 No 3, Mar 79 pp 925-929 manuscript received 25 Sep 78

LUGOVOY, V. N. Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR

[Abstract] An examination is made of light modulation in a Fabry-Perot interferometer filled with a non-dispersive (non-absorbing) dielectric under the action of a homogeneous (time-variable) electric field. The change in the electric field in time is assumed to be fast, i. e. the modulation period is less than the lifetime of a photon in the interferometer. The author predicts a "zero-point" effect that consists in disappearance of modulation of the light wave transmitted through the interferometer for a certain series of frequencies p of the modulating field (independently of the field amplitude) and for certain frequencies ω of the incident light wave. At zero points, there are singularities in the derivatives of the light wave modulation parameter with respect to the given frequencies. Attention is given to the feasibility of using this effect for measuring the absolute value of the optical length of the interferometer with precision several orders of magnitude greater than the wavelength of light (and in many instances better than the thickness of an atomic layer of matter), and also for precision measurements of deviations of the index of refraction due to different external factors such as light field, pressure, magnetic field and so on. References 13: 1 Russian, 12 Western.

[98-6610]

USSR

NONLINEAR THEORY OF STIMULATED WAVE SCATTERING BY RELATIVISTIC ELECTRON BEAMS

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 26 No 3, Mar 79 pp 930-943 manuscript received 11 Aug 78

BRATMAN, V. L., GINZBURG, N. S and PETELIN, M. I., Institute of Applied Physics

[Abstract] An investigation is made of thepractical feasibility of a new type of fast-wave tube that uses modulating beam interaction. These devices are called "scatterons" and are intended for radiating millimeter and sub-millimeter waves by scattering of relatively long waves by relativistic beams. A universal theory of scatterons is developed on the basis of averaging of the motion of an electron in rf fields, and an estimate is made of the contribution of various factors present in actual experiments such as the speread of electron velocities, Coulomb interaction and perturbation of pumping coherence. An analogy is drawn between the process of wave scattering in the scatteron and decay processes in plasma, as well as the process of electron interaction with electromagnetic waves and Chernkov devices of the TWT type. Equations are derived that describe the averaged motion of a relativistic electron in a field of two waves of differing frequencies. An investigation is made of the hydrodynamic stage of induced scattering of a wave by a relativistic electron flux. It is shown that the principal mechanism that determines saturation of gain is displacement of electron bunches from the decelerating to the accelerating phase of the Raman wave field. It is shown that

the feasibility of practical realization of scatterons depends on the possibility of producing sources of fairly dense and monochromatic electron and photon fluxes. Photon density can be increased by using high-Q cavities. It is shown that pumping coherence requirements can be met even when powers from separate oscillators are added. Ionic spacecharge compensation can be used to meet requirements of reduced energy spread of electrons in the high-density beams needed for getting the shortest-wave radiation. Estimates show that powerful relativistic microwave oscillators can be used for pumping with high-current accelerators for relativistic electron injection to get coherent radiation in the millimeter and submillimeter ranges by induced scattering. However, a relativistic ubitron is a better prospect in this wavelength range. Laser pumping is more relatistic for scatterons in the ultraviolet region. The authors thank L. A. Vaynshteyn, A. V. Gaponov, A. G. Litvak, N. F. Kovalev and A. V. Smorgonskiy for constructive criticism. Figures 3; references 7: 3 Russian, 4 Western.

[198-6610]

USSR

QUANTUM KINETIC EQUATION FOR ELECTRONS IN OPTICAL BREAKDOWN OF GASES

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 26, No 3, Mar 79 pp 944-958 manuscript received 27 Jun 78

KAS'YANOV, V. A. and STAROSTIN, A. N., Moscow Power Engineering Institute

[Abstract] A quantum kinetic equation is derived for electrons scattered by atoms in a nonresonant field of a strong electromagnetic wave. Expressions are presented for the coefficient of absorption and the real part of the permittivity of a weakly ionized plasma in the field of a strong electromagnetic wave on the frequency of the incident radiation. It is shown that when the ratio of the characteristic mean velocity to the vibrational velocity of an electron in the wave field is very small, the equations for the zeroth harmonic of the electron distribution function in the representation of the generalized and kinematic momenta coincide, even though the initial equations in these two instances are different: the quantum equation takes a finite-difference form for the generalized momentum, and is a differential equation for the kinematic momentum. An examination is made of the transition to the classical case in passage to the limit. It is shown that a classical equation of diffusion for is obtained when the parameter characterizing the mean number of absorbed photons is much greater than unit, if at the same time the vibrational velocity of an electron is much smaller than the characteristic mean velocity. An examination is made of the problem of electron scattering

by atoms (molecules) in a strong resonant field. A characteristic feature of resonant energy takeup is interference between the process of absorption of ν photons by an electron and processes in which an electron absorbs $\nu \pm 1$ electrons, while one photon is drawn off by the resonanting system. A quantum equation is derived for the distribution function of electrons in resonant breakdown of gases, and estimates are presented for the reduction of threshold intensity for atoms and molecules. The authors thank A. M. Dykhne for interest in the work and constructive criticism. Figures 4; references 30: 22 Russian, 8 Western.

[98-6610]

USSR

SPIN RESONANCE OF NONLINEAR OPTICAL SUSCEPTIBILITY IN n-InSb

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 26 No 3, Mar 79 pp 1058-1070 manuscript received 17 Aug 78

BRESLER, M. S. and GUSEV, O. B., Physicotechnical Institute imeni A. F. Ioffe, Academy of Sciences USSR

[Abstract] The authors study the spin resonance of nonlinear optical susceptibility $X^{(3)}(-\omega_3, \omega_1, -\omega_2)$ responsible for frequency mixing of the form $\omega_3 = 2\omega_1 - \omega_2$ in n-InSb over a wide range of concentrations of conduction electrons. Experiments were done with a Q-switched CO_2-laser emitting simultaneously on frequencies of $\omega_1 = 944$ cm^{-1} and $\omega_2 = 1044$ cm^{-1}. The conduction electron concentration dependence of the resonance position, line shape and resonance amplitude is well described by the quantum theory of nonlinear optical susceptibility based on solving an equation for a density matrix with consideration of the phenomenon of "dynamic narrowing" of the resonance line. Times of spin and momentum relaxation of conduction electrons are determined. It is shown that the theory of nonlinear optical susceptibility with consideration of the band structure and electron relaxation satisfactorily describes the pattern of spin resonance over a wide range of free electron concentrations. The authors thank A. G. Aronov for fruitful discussions on the topic of the paper, B. P. Zakharchene for support and interest in the work, and R. V. Parfen'yev for useful discussions and for furnishing the samples of InSb. Figures 4; references 18: 4 Russian, 14 Western.

[98-6610]

USSR UDC: [681.327.88:778.38]:546.78'221

POSSIBLE USE OF TUNGSTEN TRISULFIDE IN OPTICAL DATA PROCESSORS

Minsk DOKLADY AKADEMII NAUK BSSR in Russian Vol 23, No 5, 1979 pp 425-427
manuscript received 25 Sep 78

BUDKEVICH, B. A., GES', I. A., ZHMAKA, YE. I., KATSUBO, T. R., PILIPOVICH, V. A., and POLIKANIN, A. M., associate member of the Belorussian Academy of Sciences and ROMANOV, I. M., Institute of Electronics, Belorussian Academy of Sciences

[Abstract] The reversible electrochemical effect in thin fims of tungsten and molybdenum oxides, manifested as a change in the absorption of visible light when an electrical field is applied, reveals wide possibilities for using these materials in data display technology and to design various light shutters and modulators, electrically and optically controlled image transparencies, amplifiers and converters. New inorganic materials having simultaneous photo and electrochemical properties were sought. Thin films of WS_3 were produced by thermal resistive evaporation of tungsten trisulfide powder at 10^{-5} mm Hg. WS_3 films can be used as a reversible recording medium for entry of data of UV emission and can be erased by an electrical field, or as a material for electrically controlled image transparencies and devices. Photosensitivity is roughly one order higher than WO_3 films and electrochemical properties are somewhat better. Figure 1; references 2 Western.

[3-8617]

USSR UDC: 535.373.2;535.377

LUMINESCENT METHODS OF VISUALIZING UNSEEN IMAGES

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA FIZICHESKAYA in Russian Vol 43 No 6, Jun 79 pp 1203-1211

TIMOFEYEV, YU. P., FOK, M. V. and FRIDMAN, S. A., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR

[Abstract] In developing phosphor screens for getting visible images of fields of emission with quantum energy below that of visible light, the phosphors have to meet severe requirements with respect to absolute value of the luminescence yield η, and with respect to its dependence on conditions of excitation. For practical applications, two contradictory problems must be solved: stabilizing the luminescence yield over as wide a range of variation in excitation conditions as possible; maximizing the

sensitivity of the phosphor to small variations of the intensity of excitation I_{ex}, temperature T, or intensity of additional infrared background I_{IR}. These properties as defined by the derivatives $K_n = d\ln\eta/d\ln I_{ex}$ (degree of nonlinearity), $R_T = d\ln\eta/dT$ (temperature sensitivity) and $R_{IR} = d\ln\eta/dI_{IR}$ (optical sensitivity) should stay constant or change according to a known law over a certain range of values of I_{ex}, I_{IR} and T. In this connection, the authors make a detailed investigation of the recombination interaction of impurity centers in phosphor crystals, and also analyze the effectiveness of energy cooperation in wide-band bases with TR^{3+} ions that give direct conversion of infrared radiation to visible light. The paper gives the results of analytical and numerical computer calculations of the dependence of η on I_{ex}, I_{IR} and T. Possibilities are discussed for improving temperature-sensitive and anti-Stokes phosphors, and examples of practical applications are given. Figures 3; references 24: 23 Russian, 1 Western.

[10-6610]

USSR UDC: 535.373.2;535.377

LUMINESCENT CONVERSION OF INFRARED AND MICROWAVE RADIATION TO VISIBLE LIGHT, AND ITS APPLICATIONS

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA FIZICHESKAYA in Russian Vol 43, No 6, Jun 79 pp 1303-1312

TIMPFEYEF, YU. P. and FRIDMAN, S. A., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR

[Abstract] An examination is made of various luminescent methods for converting longer-wave radiation to visible light contrary to the Stokes rule. Estimates are made of the sensitivity of activated phosphor crystals to the optical and thermal action of infrared rays, and a comparison is made with the corresponding experimental data. The authors discuss processes of direct conversion of infrared rays to visible light in phosphors with cooperation of energy of excitation of TR^+ ions. Examples are given of applications of the three indicated classes of luminophors for visualizing infrared and microwave fields, and also for studying the heat conditions of various objects. It is shown that the various classes of phosphors that are sensitive to infrared rays have very different properties that determine the possibilities for existing and new applications. A table is given summarizing the principal characteristics of phosphors for visualizing infrared radiation. Figures 4; references 40: 35 Russian, 5 Western.

[10-6610]

USSR UDC: 535.375.5

UP-CONVERSION OF IR EMISSION BY RESONANT NONLINEAR OPTICS METHODS

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA FIZICHESKAYA in Russian Vol 43, No 7, Jul 79 pp 1467-1479

POPOV, A. K., Institute of Physics, Siberian Department, Academy of Sciences USSR

[Abstract] The paper gives a brief survey of results of research on converting weak infrared emission and the radiation of powerful infrared lasers to emission in the visible and near ultraviolet regions of the spectrum in resonant nonlinear media. It is shwon that when resonant nonlinear processes are used in gaseous media, the outlook is good for up-conversion of infrared readiation to the visible and near UV, and also within the IR band. Such devices can supplement the available nonlinear crystal devices, considerably extending the field of applications of nonlinear optics. More research is needed on resonant nonlinear effects in atoms and molecules to advance the work in this field. References 31: 21 Russian, 10 Western.

[11-6610]

USSR

TIME DISPERSION OF PHOTOELECTRONS IN AN ELECTRON-OPTICAL IMAGE CONVERTER

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 49 No 8, Aug 79 pp 1710-1713 manuscript received 4 Dec 78

PLATONOV, V. N. and SHCHELEV, M. Y. A., Moscow, Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] The time variance of photoelectrons in an electron-optical image converter (EOIC) is due to the scatter of initial electron velocities during passage from the photocathode to the screen. In this connection a new formula describing this form of variance in a cathode-grid EOIC is presented. Calculations based on this paraxial-approximation formula yield a time dispersion diverging from the previously known formula by a factor of 2.5 as verified by comparison of theory with experiment with respect to the potential distribution along the axis in three types of EOIC used in high-speed photography. The new formula is of importance to determining the time resolution of a superfast EOIC on a picosecond time scale. Figure 1; references 4: all Russian

[32-1386]

USSR UDC: 537.533.3

THE BIPLANAR ELECTRON-OPTICAL IMAGE CONVERTER AS A CIRCUIT COMPONENT

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 49 No 9 Sep 79
pp 1966-1969 manuscript received 4 Dec 78

KRASNOV, V. F. and TUROVSKIY, L. A., Novosibirsk Institute of Automation and Electrometry, Siberian Affiliate of the USSR Academy of Sciences

[Abstract] Electron-optical image converters with direct image transfer (biplanar EOIC) are widely used as pulse shutters in physics experiments. In this connection, the properties of biplanar EOIC as an electrical two-terminal network are investigated; in particular, a formula for the admittance $G(\omega)$ of EOIC is derived. It is shown that at high frequencies the admittance is no longer of the capacitive susceptance kinds. The frequency dependences of the real Re $G(\omega)$ and imaginary Im $G(\omega)$ parts of the admittance of EOIC are computed. A method for determining the surface resistance of the photocathode with the aid of experimentally derived RE $G(\omega)$ [or Im $G(\omega)$] dependence is presented. This is of interest since knowledge of the frequency dependence of $G(\omega)$ makes it possible to match EOIC better to its control pulse source and, secondly, analysis of the function $G(\omega)$ derived experimentally for every particular device makes it possible to determine the surface resistance ρ of the concerned photocathode, which is particularly important since it is not feasible to directly measure the ρ of the completed device. Clearly, in the general case EOIC admittance depnds on the illumination level. Figurel; references 3: all Russian.

[33-1386]

USSR UDC: 533.9

ESTIMATE OF THE CROSS SECTIONS OF DEPOLARIZATION BY ELECTRON IMPACT IN A GAS DISCHARGE PLASMA

Leningrad OPTIKA I SPEKTROSKOPIYA in Russian, Vol 47, No 1, Jul 79, pp 191-192 manuscript received 23 Nov 78

KAZANTSEV, S. A. and RYS', A. G.

[Abstract] This work is a continuation of earlier works in which the effect of atomic alignemnt in a gas discharge plasma was used to determine the lifetime and cross sections of depolarizing collisions with normal gas atoms for a large group of excited states of inert gas atoms. The present work attempts to estimate the cross sections of depolarization bye electron collisions. The corss sections of electron collision disruption of alignment of atoms in the plasma of the discharge are listed. Figure 1; references 9 Russian.

[169-6508]

USSR

FAST IONS IN A LASER PLASMA

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 26, No 3, Mar 79 pp 976-990 manuscript received 1 Sep 78

ANDREYEV, N. YE., ZAKHARENKOV, YU. A., ZOREV, N. N., TIKHONCHUK, V. T. and SHIKANOV, A. S., Physics Institute imeni P. N. Lebedev, Academy of Sciences USSR

[Abstract] An important problem in laser-driven fusion is to determine how absorbed energy is redistributed in the plasma and how accelerated particles are generated. Experiments on the Kal'mar nine-channel laser facility with heating of both solid and shell targets against a background of spherically symmetric expansion of the plasma corona have revealed a new effect of jet acceleration of particles to high energies (of the order of 0.5 MeV). The authors examine the physical essence of this effect and calculate the main characteristics (number and energy) of the fast particles. It is shown by analyzing possible mechanisms of acceleration that the effect is due to pondermotive acceleration of ions in the region of critical density of laser radiation resonantly amplified by an electric field. A theory of resonant acceleration of ions is proposed that accounts for nonlinear interaction of plasma waves in the region of critical density. Estimates of the energy and number of fast ions agree with experimental data. Figures 7; references 29: 20 Russian, 9 Western.

[98-6610]

USSR UDC: 533.932:533.601.18:
539.198

INFLUENCE OF ATOMIC WEIGHT OF THE TARGET ON THE ACCOMMODATION COEFFICIENT OF ION ENERGIES IN A FLOW OF PARTIALLY IONIZED GAS

Novosibirsk ZHURNAL PRIKLADNOY MEKHANIKI I TEKHNICHESKOY FIZIKA in Russian, No 3, May/Jun 79 pp 83-87 manuscript received 28 Mar 78

SHUVALOV, V. A., Dnepropetrovsk

[Abstract] Results are presented from measurement of the values of the energy accommodation coefficient in a high velocity stream of rarefied plasma. The experimental studies were performed on a gas dynamic plasma installation in a flow of a rarefied plasma generated by an accelerator in which the working substance was ionized by electron impact. The spread of measured balues of the accommodation coefficient is not over 7.5%. Figures 3; references 13: 12 Russian, 1 Western.

[168-6508]

USSR UDC: 533.95

COMPRESSION OF PLASMA EDDY BY MEANS OF A LINER

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 49 No 8, Aug 79 pp 1748-1750 manuscript received 27 Sep 78

KUZ'MIN, G. A. and LIKHACHEV, O. A., Novosibirsk, Institute of Heat Physics, Siberian Affiliate of the USSR Academy of Sciences

[Abstract] The rotation of plasma by means of electromagnetic fields is an effective plasma preheating method; the effect of this rotation can be markedly enhanced by subjecting a rotating plasmoid to rapid compression by means of a metal wall (liner); this can be used as a technique for achieving the temperatures needed to accomplish thermonuclear fusion. In this connection, numerical calculations of the liner-induced compression and subsequent cooling of a cylindrical plasma eddy in an axial magnetic field are presented. The evolution of the plasma eddy upon compression is investigated within the framework of equations of one-fluid plasma dynamics with allowance for viscosity, heat conductivity, electrical conductivity, electron heat flux, and loss of energy on radiation. It is shown, that within a specified range of parameters, rotation markedly raises the maximum temperature and prolongs the lifespan of the plasma, and that increasing the rate of viscous dissipation of the energy of vortical motion further enhances that temperature. Figures 2; references 4: 1 Russian, 3 Western.

[32-1386]

USSR UDC: 533.951.18

ENERGY SPECTRA OF PLASMA ELECTRONS AND IONS IN AN ELECTROMAGNETIC TRAP

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 49 No 9 Sep 79
pp 1885-1887 manuscript received 23 Oct 78

KOMAROV, A. D., LAVRENT'YEV, O. A., POTAPENKO, V. A. and STEPANENKO, I. A.,
Khar'kov Physico-Technical Institute, UkrSSR Academy of Sciences

[Abstract] Plasma can be generated in electromagnetic traps by, among other methods, the ionization of gas within the trap by means of electrons injected from outside. This method serves to build up in the trap a plasma with high ion energies due to the motion of ions in the field of the potential well produced by the electrons. For this method of plasma generation, the ion energy differs depending on thelocus of ion production in the potential well. In this connection, formulas for the energy distribution of the electron and ion components of the plasma emerging from the electromagnetic trap upon cutoff of voltage are derived. It is shown that in the presence of cutoff voltage the ions virtually do not emerge from the trap. A relationship between the rate of disappearance of the potential well and the rate of emergence of the flux of uncompensated electrons is established. Analysis of the ion energy spectrum of the plasma generated by the ionization of residual gas by the electron beam is used to determine the mean ion temperature and to derive the relation of the mean ion energy to the electron injection energy. The derived coupling factor for $\overline{W}_i$ and $W_{e\ inj}$ is found to be in agreement with theory. Figures 6; references 2 Russian.

[33-1386]

USSR UDC: 535.211.621.378.52

INVESTIGATION OF THE EROSIONAL PLASMA ARISING UPON THE LASER IRRADIATION (POWER DENSITY 10^9-10^{11} watt/cm^2) OF TRANSPARENT DIELECTRICS

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 49 No 9 Sep 79
pp 1905-1909 manuscript received 23 Jun 78; after editing, 28 Dec 78

VOROB'YEV, A. N., DANIEL', YE. V. and PAVLOVSKAYA, N. A.

[Abstract] When a luminous flux with a power density Q exceeding 10^8 watt/cm^2 acts on the surface of a solid dielectric, the process of the interaction between light and matter begins to be markedly affected by erosional plasma. In this connection, the interaction between the radiation of a neodymium laser and optical glasses and LiF crystals was investigated within the range of laser-flux power densities $Q \simeq 10^9$-$5 \cdot 10^{10}$ watt/cm^2. The kinetics

of the erosional laser plasma as well as the absorption, reflection, and attenuation of laser radiation by that plasma were investigated. A strongly absorbing ($\varkappa \approx 4$-8 cm^{-1}) core was discovered in the plasma jet; at Q $\lesssim$ 10^{10} watt/cm^2 this core is located in the neighborhood of the dielectric's surface, whereas at Q $\gtrsim 10^{10}$ watt/cm^2 it begins to travel counter to the laser beam at a rate of $\simeq$ 100 km/sec. The movement of the absorbing core is associated with singularities of the time course of the absorption index of the erosional plasma. Figures 5; references 13: 11 Russian, 2 Western.

[33-1386]

USSR UDC: 533.95

OBSERVATION OF THE SCATTERING OF CO_2 LASER RADIATION ON MICROFLUCTUATIONS OF PLASMA DENSITY

Leningrad TEKHNICHESKOY FIZIKI in Ru-sian Vol 49 No 9 Sep 79 pp 1910-1912 manuscript received 4 Jan 79

BULANIN, V. V., ZHILINSKIY, A. P., PETROV, A. V. and USHAKOV, S. N., Leningrad Polytechnic Institute imeni M. I. Kalinin

[Abstract] When CO_2 lasers (λ_0 - 10.6 um) are used, plasma waves on the scale λ_p = 0.1-5 mm can be used. Accordingly, the scattering of the radiation of a CO_2 laser by the azimuthal osciallations of the plasma column of a heavy-current hollow-cathode arc discharge in a magnetic field was investigated. The discharge current intensity was 1 kilo-ampere in the presence of an argon pressure of $6 \cdot 10^{-4}$ torr and a magnetic field of 1,450 kilo-oersted. The plasma concentration in the axial region of the discharge was 10^{14} cm^{-3} and the electron temperature was 6-8 eV. The plasma column was found to develop a nonlinear pattern of instability with the spectrum of oscillations ranging from 0.5 to 25 MHz and decaying in the region of high frequencies. The perturbations extended in the aximuthal direction. The high-frequency part of the spectrum of oscillations was investigated according to the small-angle (5-30 mrad) scattering of the radiation of a 40-KW TEA CO_2 laser. The angular distribution of the scattered radiation corresponded to scattering by plasma waves propagating at right angles to the lines of force of the magnetic field. The deformation of the time spectrum of plasma waves observed at various scattering angles was used to derive the corresponding dispersion relation. The phase velocity of the oscillations ranged within $5 \cdot 10^5$-10^6 cm/sec. When parasitically scattered radiation is used as the reference signal, quantitative information can be derived on the intensity of the scattered radiation and by the same token the rate of density fluctuations can be estimated. Figures 2; references 10: 3 Russian, 7 Western.

[33-1386]

USSR UDC: 539.3:534.1

AN EXPRESSION FOR THE FREQUENCY DISTRIBUTION FUNCTION CHARACTERIZING A SHELL OF REVOLUTION IMMERSED IN A FLUID

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 248, No 2 1979 pp 325-328 manuscript received 11 May 79

VASIL'YEV, D. G., Moscow Physico-Technical Institute, Dolgoprudnyy (Moscow Oblast)

[Abstract] Under consideration is a closed shell which has been generated by rotation of the arc of a curve about an axis. This shell, its wall thickness regarded as a small parameter, is immersed in an infinitely large volume of an ideal compressible fluid where it freely vibrates. From the fundamental equations of motion with domal boundary conditions at the vertices, two independent series of natural frequencies are found in the complex plane and respective asymptotic expressions are obtained for each on the basis of two theorems about the intervals on which they exist. The author thanks professor V. B. Lidskiy for formulating the problem and assisting in the study. The article was presented by Academician P. Ya. Kochinoy on 5 Mar 79. References: 8 Russian.

[46-2415]

USSR UDC: 531.01+534

GENERAL THEORY OF VIBROPROTECTION OF DYNAMIC SYSTEMS

Kiev DOPOVIDI AKADEMIYI NAUK UKRAYINS'KOYI RSR. SERIYA A. FIZYKO-MATEMATYCHNI TA TEKHNICHNI NAUKY in Ukrainian No 6, Jun 79 pp 429-432 manuscript received 20 Jan 79

SHCHERBYNA, YE. S., Kiev Polytechnic Institute

[Abstract] The theory of vibroprotected mechanical systems with systems of passive and active vibroprotection has developed in three directions. The first is associated with properties of the mechanical/vibroprotection system and is based on linear and non-linear oscillation theory. The second is based on classic results of automated control and optimum regulation theory. The third is the technical realization of vibroprotection systems based on the first and second directions. Topological formalization is employed to assure necessary and adequate conditions of vibroprotection of dynamic systems. References: 14 Russian.

[145-8617]

USSR UDC: 539.3

THE PROBLEM OF CONSTRUCTING A THEORY OF STABILITY FOR THIN SHELLS

Kiev DOPOVIDI AKADEMIYI NAUK UKRAYINS'KOYI RSR. SERIYA A. FIZYKO-MATEMATYCHNI TA TEKHNICHNI NAUKY in Ukrainian No 6, Jun 79 pp 437-440 manuscript received 5 Jan 79

HUZ, A. N., Institute of Mechanics, Ukrainian Academy of Sciences

[Abstract] Construction of a linear theory of stability of thin shells is considered under the influence of "tracking" loads for the case of small precritical deformations, when the initial state is defined by geometrically linear theory, because this version of the theory is most prevalent in applied research. The question of analysis of components of a "tracking" load was studied using this linearized theory because this point is general in statement of problems of stability of thin shells for any model; sometimes the end result is completely dependent on the accuracy of solution of this problem. References: 7 Russian.

[145-8617]

USSR UDC: 532.4:534.2

RADIATION OF AN ACOUSTIC PRESSURE WAVE BY A LINEAR SOURCE OF EXPLOSION INTO AN INFINITE MEDIUM

Kiev DOPOVIDI AKADEMIYI NAUK UKRAYINS'KOYI RSR. SERIYA A. FIZYKO-MATEMATYCHNI TA TEKHNICHNI NAUKY in Ukrainian No 6, Jun 79 pp 456-458 manuscript received 4 Nov 78

PODSTRIHACH, YA. S., Academician, Ukr Academy of Sciences; PIDDUBNYAK, O. P., and TYKHONENKO, V. V., L'vov Branch of Mathematical Physics, Ukrainian Academy of Sciences Institute of Mathematics and Institute of Geophysics

[Abstract] Explosion of a linear charge of uniform desnity, detonated instantaneously and with finite velocity, into an infinite medium is investigated. Such charges assure energy concentration in the required direction. Solution was derived in linear approximation. At time zero, the medium receives a pulsed perturbation uniformly distributed along the Z axis in a system of cartesian coordinates through a section of H length. This case exists with explosion of a linear charge, if instantaneously detonated. The relationship of pressure and radius is graphically demonstrated. The solution can aid in analyzing pressure fields in acoustic media near a linear charge. Figures 3; references 4 Russian.

[145-8617]

USSR

ACHIEVEMENT OF SUPER-HIGH PRESSURE BY MEANS OF ANVILS OF CARBONADO (POLYCRYSTALLINE DIAMONDS)

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI Vol 20 No 5 Sep 79 pp 286-290 manuscript received 20 Jul 79

BRANDT, N. B., BERMAN, I. V. and SIDOROV, V. I., Moscow State University imeni M. V. Lomonosov

[Abstract] In the present work, high pressures were achieved using chambers made of carbonado. In contrast to ordinary high-pressure chambers which have axial symmetry, the chamber developed by the authors consists of two anvils, one of which is in the form of a truncated pyramid, while the other is flat. The specimen, in the form of a thin film, is applied or precipitated on the surface of the flat anvil. The total area of contact of the two anvils is 0.01 x 0101 mm. The measurement electrodes are vacuum deposited lead strips 10-15 μm wide. Figures 3; references 5: 4 Russian, 1 Western.

[36-6508]

USSR UDC: 539.4.25

FRACTURING STRESSES INDUCED BY INSTANTANEOUS IMPACT

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 49 No 8, Aug 79 pp 1786-1788 manuscript received 13 Dec 78

ZLATIN, N. A., PUGACHEV, G. S. and STEPANOV, V. A., Leningrad, Physico-Technical Institute imeni A. F. Ioffe, USSR Academy of Sciences

[Abstract] The steadily widening range of applications of impact methods of metalworking (welding, forging, explosion hardening, etc.) require the development of procedures for computing the attendant processes. In particular, a method for computing fracturing stresses produced by short-impact (10^{-7}-10^{-5} sec long) loading of solids is presented. A formula for calculating the fracturing stress for metals at room temperature when subjected to 10^{-6} sec long impact is presented. The calculations apply, strictly speaking, only to stable metals and alloys, but experience shows that they can also be applied to strain-aged alloys. Experimental findings on impact tests of aluminum and an aluminum-based strain-aged alloy are in agreement with theory. Figure 1; references 15: 12 Russian, 3 Western.

[32-1386

USSR UDC: 537.312.62

THE "QUANTUM POLARIZATION" EFFECT OF HOMOGENEOUS SUPERCONDUCTORS IN AN ELECTROMAGNETIC FIELD OF CRITICAL FREQUENCY

Tomsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY FIZIKA in Russian, No 7(206), 1979, pp 122-124 manuscript received 28 Jun 78

NAIMI, YE. K., Moscow Institute of Steels and Alloys

[Abstract] The quantum effect of development of a steady electric field in the volume of a homogeneous and isotropic superconductor under the influence of electromagnetic radiation at a critical frequency is studied. It is shown that the steady electric field induced in the volume is propertional to the intensity of radiation and decreases exponentially with distance. It is shown that in the general case of a heterogeneous and nonisotropic superconductor, both an electric field and a heterogeneous steady magnetic field arise in the volume of the superconductor. This effect, referred to as "quantum polarization," is a basically new phenomenon, though quite similar to several others. The essence of the phenomenon is described. REferences 10: 7 Russian, 3 Western.

[18-6508]

USSR

THE STRUCTURE OF THE SUPERDIAMAGNETIC STATE

Moscow PIS'MA v ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI Vol 30 No 6 20 Sep 79 pp 317-320 manuscript received 13 Jun 79

VOLKOV, B. A., KOPAYEV, YU. V., NUNUPAROV, M. S. and TULUSHEV, V. V., Institute of Physics imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] This work demonstrates that systematic consideration of interzone interactions in systems with electron-hole pairing causes the homogeneous current to vanish. However, at temperature T_{Im}, a magnetic field H should spontaneously arise even without magnetic induction B. The calculations indicate that the structure of the superdiamagnetic state is quite sensitive to the characteristics of high-temperature phase symmetry. References 8: 7 Russian, 1 Western.

[37-6508]

USSR

THE THEORY OF SUPERDIAMAGNETIC MATERIALS

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI Vol 30 No 6 20 Sep 79 pp 345-349 manuscript received 10 Aug 79

GINZBURG, V. L., Institute of Physics imeni P. N. Lebedev, USSR Academy of Sciences

[Abstract] This article draws attention to the great "reserves" available in the description of superconducting and superdiamagnetic systems by means of the order parameter—the complex macroscopic wave function Ψ . The new capabilities discussed by the author are related primarily to the consideration of temperature variation of the coefficient m^*. An expression is derived which can extend the ordinary theory of superconductivity to the case in which coefficient m^* depends on temperature, and m^* or $1/m^*$ passes through zero. One system which is of interest in this area is a dielectric which converts immediately to the superconducting state, bypassing the metallic state. References 12: 10 Russian, 2 Western.

[37-6508]

USSR UDC: 530.11:531.18

CONCERNING THE PROBLEM OF THE RELATIVISTIC KINETIC EQUATION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 247, No 5 1979 pp 1119-1123 manuscript received 27 Apr 79

GALITSKIY, YU. B., associate member of the Academy of Sciences USSR, IVANOV, YU. B., and KHANGULYAN, V. A., Institute of Atomic Energy imeni I. V. Kurchatov, Moscow Engineering Physics Institute

[Abstract] There has been a recent upsurge of interest in the theory of Boltzmann's relativistic kinetic equation and thekinetics of a relativistic gas. This is due in part to the traditional interst in relativistic kinetic processes in a high-temperature plasma. On the other hand, research has recently developed intensely in the physics of high-energy collisions of heavy ions. The kinetic equation is a good basis of rmore precise theoretical investigation of such collisions. Astrophysics is another field of application of the relativistic kinetic equation. This paper gives the systematic relativistic derivatior of Boltzmann's kinetic equation. The equation has a relativistic-invariant form, and the integral of collisions is written in terms of the invariant differential cross section $d\sigma/dt$ (t is the invariant square of the transmitted momentum). In this, the authors differ from others who have written the integral of collisions in terms of the transition probability, which is inconvenient for practical applications. It is shwon that the derived equation is identical to Boltzmann's kinetic equation in the nonrelativistic limit. References 5: 4 Russian, 1 Western.

[19-6610]

USSR UDC: 530.12

THE INFLUENCE OF A MASSIVE READING SYSTEM ON THE INDICATIONS OF MEASUREMENT INSTRUMENTS

Tomsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY FIZIKA in Russian, No 7(206), 1979, pp 67-71 manuscript received 30 May 78

SADYKOV, B. S., Moscow Printing Institute

[Abstract] It was shown earlier that a reading system, in contrast to a coordinate system, is a physical reality and must be related to massive bodies. However, massive bodies curve space, thereby influencing the course of processes and, therefore, the coordinates of a reading system, related to such bodies, depend on both kinematic and gravitational fields

of the reading body. This dependence must be considered in all conversion formulas. The author has distinguished a group of massive bodies which is rather inertial in the kinematic aspect. In this work, an explicit expression is derived for the energy of signals in such a system. Even in the quasi classical approach approximation, consideration of the field of the reading body itself leads to results which are much more general than can be achieved within the framework of the linear theory. Figure 1, reference 1 Russian.

[18-6508]

USSR

THE EFFECT OF THE GRAVITATIONAL FIELD ON MOTION AND RADIATION OF RELATIVISTIC PARTICLES IN A MAGNETIC FIELD AND A PARALLEL ELECTRICAL FIELD

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 30 No 4, 20 Aug 79 pp 230-233 manuscript received 3 Jul 79

GUREVICH, L. E. and DYNKIN, S. D., Physicaltechnical Institute imeni A. F. Ioffe, USSR Academy of Sciences

[Abstract] Neutron stars have a strong gravitational field and a strong magnetic field. If the magnetic axis does not coincide with the axis of rotation or the magnetic field is variable for other reasons, an electrical field occurs which accelerates charged particles. A model is devised to avoid the unwieldly computations required to describe these effects. Magnetic-retardation radiation shows the qualitative differences from the corresponding effect in special relativity theory. Because the sign of change of beta$_{\perp}$ is a function of particle energy, for particles of different energies radiation is maximum in different directions. In special relativity theory, this effect is virtually nil, because as particle energy increases its transverse velocity diminishes, and with it, its emission. References 2 Russian.

[162-8617]

USSR

NEW CONCEPTS OF SPACE-TIME AND GRAVITATION

Moscow TEORETICHESKAYA I MATEMATICHESKAYA FIZIKA in Russian Vol 40 No 3, Sep 79 pp 291-328 manuscript received 28 May 79

LOGUNOV, A. A., DENISOV, V. I., VLASOV, A. A., MESTVIRISHVILI, M. A. and FOLOMESHKIN, V. N., Deceased, Institute of High-Energy Physics

[Abstract] The main purpose of this work is to construct a new theory of gravitation, in which the gravitational field is a physical field with energy-momentum density. This leads to certain new concepts concerning space-time. The theory of gravitation is formulated as a symmetrical tensor field in flat space-time. The equations of motion of matter are formulated in terms of effective space-time, providing equality of inert and gravitational masses of a point body. The union of the concepts of the gravitational field as a physical field, carrying energy and thus analogous to other physical fields, with the principle of identity, leads to new equations for the gravitational field, which are nonlinear due to nonlinearities in the variation of the source with components of the gravitational field. Outside of matter, the equations of the field are linear. Future works will show that the theory successfully describes experimental facts and can be united with quantum concepts. References 18: 9 Russian, 9 Western.

[22-6508]

USSR

EQUATIONS OF MOTION FOR SCALAR AND SPINOR FIELDS IN A FOUR-DIMENSIONAL NONEUCLIDEAN MOMENTUM SPACE

Moscow TEORETICHESKAYA I MATEMATICHESKAYA FIZIKA in Russian Vol 40 No 3, Sep 79, pp 363-372 manuscript received 8 Aug 77

VOLOBUYEV, I. P., KADYSHEVSKIY, V. G., MATEYEV, M. D. and MIR-KASIMOV, R. M., Joint Institute of Nuclear Research

[Abstract] A new formulation has been presented for quantum field theory, in which a four-dimensional momentum space of constant curvature, or p-space, plays an important role. This article produces extensions of the equations of motion of free fields for the new formulation of the theory. The equations lead to modified expressions for propagators and, consequently, to a new description of virtual particles in the region of superlarge energies and momentums. The new equations of motion require a redefinition of the operation of spatial inversion. References 10: 8 Russian, 2 Western.

[22-6508]

USSR

STOCHASTIC OSCILLATIONS OF A PARAMETRICALLY EXCITED NONLINEAR NETWORK

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 26 No 3, Mar 79 pp 991-999 manuscript received 1 Sep 78

YEZERSKIY, A. B., RABINOVICH, M. I., STEPANYANTS, YU. A. and SHAPIRO, M. F., Institute of Applied Physics, Academy of Sciences USSR

[Abstract] An examination is made of the mechanism of development of turbulence in an ensemble of parametrically excited waves in a one-dimensional nonlinear medium--a periodic lattice--in which the law of dispersion in the long-wave approximation coincides with the spectrum of ion-acoustic waves in a plasma. It is shown that the turbulent state that arises in such a medium may not involve a large number of waves of different frequencies. As the amplitude of the external field increases, parametric turbulence arises even after a small number of passes, abruptly replacing the regular steady state. The identical nature of the transitions obserbed in a resonator and in a matched network, and also the similarity of the spatial structure of the fields in the preturbulent state with discrete frequency spectrum and in the stochastic state with continuous spectrum are evidence that the investigated turbulence originates through nonlinear interaction of a small number of modes, and is not due to amplification of fluctuations. The "strange attractor" is a mathematical model of such turbulence. The authors thank A. V. Gaponov, V. S. L'vov and A. L. Fabrikant for fruitful discussion. Figures 7; references 8: 6 Russian, 2 Western.

[98-6610]

USSR

FLUCTUATION-DISSIPATION RELATIONS FOR NONEQUILIBRIUM PROCESSES IN OPEN SYSTEMS

Moscow ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 26 No 3, Mar 79 pp 1071-1088 manuscript received 18 Aug 78, after revision 21 Oct 78

BOCHKOV, G. N. and KUZOVLEV, YU. YE., Gor'kiy State University imeni N. I. Lobachevskiy

[Abstract] In a previous paper [G. N. Bochkov, Yu. Ye. Kuzovlev, "Zhurnal eksperimental'noy i teoreticheskoy fiziki," Vol 72, p 238, 1977] the authors derived a generating formula for a complete set of universal fluctuation-dissipation relations. These relations, whcih are a consequence of the reversibility of microscopic motion in time and the extremum

properties of thermodynamically equilibrium states, give the statistical characteristics of equilibrium thermal fluctuations in terms of the characteristics of non-equilibrium (and nonlinear) processes in a system acted upon by a dynamic external perturbation. In this paper, the authors derive fluctuation-dissipation relations for currents in the steady nonequilibrium state from the general formulas presented in the previous work. The expressions are generalized to the case of open systems, and are used to analyze the universal relations between dissipative and fluctuation processes. General expressions are found for the nonlinear transfer coefficients in terms of the fluctuation characteristics of the system (diffusion factors). As an application of the general theory it is shown that there is a close relation between the statistics of charge transfer through a p-n junction and the form of the current-voltage characteristic of the junction. An examination is made of the general structure of a Markov model of fluctuations in nonequilibrium states that is constructed in accordance with exact fluctuation-dissipation relations. An examination is also made of special systems for which the fluctuation-dispersion theorem is satisfied in its ordinary equilibrium form even in nonequilibrium states. References 9: 8 Russian, 1 Western.

[98-6610]

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